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Haute école de gestion
Genève

Should Swiss pension funds implement long-term financial derivative instruments to reduce their longevity risk?

Bachelor Project submitted for the degree of
Bachelor of Science HES in International Business Management

by

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Geneva, June 4th 2018
Haute école de gestion de Genève (HEG-GE)
International Business Management

Hes·so GENÈVE
Haute Ecole Spécialisée
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Declaration

This Bachelor Project is submitted as part of the final examination requirements of the Haute école de gestion de Genève, for the Bachelor of Science HES-SO in International Business Management.

The student accepts the terms of the confidentiality agreement if one has been signed. The use of any conclusions or recommendations made in the Bachelor Project, with no prejudice to their value, engages neither the responsibility of the author, nor the adviser to the Bachelor Project, nor the jury members nor the HEG.

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Geneva, June 4th, 2018

Vincent TURIN

Acknowledgements

I would like to thank Mr. Courbage for the supervision of this project and for his precious comments. Moreover, this project would not have been possible without the help of professionals that I interviewed. For that, I would like to thank Mr. Beguet, Mr. Beun, Mr. Klein, Mr. Hostettler, Mr. Romanens and Mr. Maeder for the time they spent to share their knowledge and answer my questions. Finally, I would like to thank Mrs. Sengupta, Mrs. Turin, Mrs. and Mr. Maytain for the proofreading of this paper.

Executive Summary

During the last decades, the Swiss population has been experiencing an increase in life expectancy. Switzerland has seen a changed in the structure of its population. In 1900, the proportion of people aged below 20 years old was 40.7% of the total Swiss population, whereas in 2016, this percentage was 20.1%. In contrast, the proportion of people aged over 60 years old has increased significantly from 5.8% to 18.1% of the total Swiss population (Office fédéral de la statistique 2018). The shift to a more ageing population is bringing new challenges to the society.

This bachelor project tackles the challenge of longevity risk faced by Swiss pension funds. “Longevity risk is the risk of populations living longer than expected—for example, through medical advances or declining health risks such as smoking. It is a global challenge driven by the ongoing substantial increases to postretirement life expectancy and is systematic in nature.” (Gavin 2013)

The increase in longevity risk can restrain the ability of pension funds to respect their commitments towards their current and future beneficiaries. In the worst cases, pension funds could face financial distress and go bankrupt. This study focuses on the potential benefits for Swiss pension funds of using long-term financial derivative instruments to transfer their longevity risk to potential investors. In the United-Kingdom a country facing similar challenges as Switzerland, these financial instruments are widely used and seem to be an efficient technique to share longevity risk among different participants. The goal of this project is to find out if this solution is applicable in Switzerland and determine what are the main barriers for the implementation of these instruments. The results of this paper are based on analytical research and on interviews of professionals. This project reveals that the occupational pension systems of both countries have been built differently. The longevity risk is not borne in the same way in Switzerland than in the UK. In Switzerland, a private company and its pension fund are two separate entities, whereas in the UK they are a single organisation. This means that a private company in the UK is fully liable for the activities and commitments of its pension fund. In Switzerland, private companies have less responsibilities. Therefore, the incentive to transfer longevity risk to third parties is less important in Switzerland. The potential providers of these derivative instruments (investment banks, insurance and reinsurance companies) look for transferring significant quantity of risk. For them, a pension fund is interesting if it has at least 5 billion of US Dollars in its balance sheet (Appendix 5 Interview Mr. Maeder). This is a big barrier for Swiss pension funds. The country counts mainly small

pension funds. In 2015, only 7.68% of the Swiss pension funds had more than one billion in their balance sheets (Appendix 3 Interview Mr. Hostettler). Moreover, some of these large players do not have the willingness to transfer their longevity risk as they have States as guarantors. The providers of solutions (investment banks, insurance and reinsurance companies) are not able to attract smaller pension funds due to the high prices of their products. For these reasons, it is not profitable for most of the Swiss pension fund to implement long-term financial derivative instruments to reduce their longevity risk and not interesting for the providers to develop the market of these instruments in Switzerland.

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1. Introduction

Problem statement

In most of developed countries life expectancies are increasing significantly and birth rates are at impressively low levels. These facts lead to an increase in age of the populations and an increase in longevity risk.

Due to ageing-populations, pension funds are struggling to guarantee the rents of future retired people and must find a way to respect their commitments. In order to do that the pension funds try to optimize their investments and try to transfer their possible risks of insolvency. In 2016 in Switzerland there were 3.4 active people for one retired. This ratio could move to two actives for one retired in the middle of the century (Mariani, Nguyen 2016).

The longevity risk impacts many different actors such as governments, pension funds, individuals, private companies. To face this risk, investment banks, insurance and reinsurance companies could bring their contribution by proposing financial instruments that would guarantee predictable future cash flow's level to pension funds. Pension funds could transfer a part of the risks linked to their occupational pension plans and hedge their liabilities. The providers (investment banks, insurance and reinsurance companies) could sell their new products and diversify their investments. This project will try to show how long-term financial derivative instruments such as longevity/survivor bonds, swaps and forward contracts can help pension funds to transfer their longevity risk. This paper also tackles the role played by insurance products such as buy-ins and buy-outs to mitigate longevity risk. The last subject addressed in this study, is the reform of the supplementary benefit (Prestation Complémentaires PCs) and its impact on the longevity risk of pension funds. Indeed, one measure of this reform was to prohibit the withdrawal of the mandatory part of the second pillar. This measure was rejected by the National Council in May 2018.

1.1 Research questions

Should Swiss pension funds implement long-term financial derivative instruments to reduce their longevity risk? Who could be the main players and providers of longevity/survivor bonds, longevity swaps and q-forward contracts in Switzerland?

Literature Review

It exists several definitions of longevity risk. However, all of them are truly similar.

“Longevity risk refers to the risk that actual survival rates and life expectancy will exceed expectations or pricing assumptions, resulting in greater-than-anticipated retirement cash flow needs.” (Blake, Morales 2017)

“Longevity risk is the risk of populations living longer than expected—for example, through medical advances or declining health risks such as smoking. It is a global challenge driven by the ongoing substantial increases to postretirement life expectancy and is systematic (undiversifiable) in nature.” (Gavin 2013)

Gavin defines what longevity risk is and why it is going to be a massive challenge for our society. He also tackles the motivations and the interests that reinsurance companies have to support these risks.

“Longevity is a systematic risk (undiversifiable) but it can be hedged or transferred to allow society to more easily absorb the risk.” (Tamm, Kirkova 2011). Tamm and Kirkova explain the different longevity risk solutions available on the North American market and how they can fit the need of pension funds. They also highlight that the demand for long-term financial derivative instrument is huge. North American pension funds are truly willing to hedge and transfer the risks that they are currently carrying. This significant demand explains the development of this market. Finally, their paper also describes the longevity risk that face the providers of these financial instruments (investment banks, insurance and reinsurance companies).

The article “Building a Capital Market” written by Mcmullan, and his colleagues explains that capital market should be an essential element to manage the increase of longevity risk. The potential financial impacts and risk for pension funds on having a person living one year longer than expected is also measured. Furthermore, this paper explains the reasons why reinsurances companies are the ones, which are the best designed to propose long-term financial derivative instruments. Finally, this article provides insights on what we should pay attention to create an efficient capital market for longevity risk (Mcmullan, Wolonglewicz, Singelton 2012).

“Underestimating life expectancy by just one-year – a relatively small miscalculation, it could easily be higher –– can increase liability by up to 5% for pension funds” (Singleton, Thomsen, Yiasoumi 2010). This paper highlights the challenges linked to the increase of longevity risk in our societies and explains the limited capacities/resources of

reinsurance companies to bear longevity risk. It also points out the necessity of building up a capital market for longevity risk.

1.2 Research methods

This bachelor research is based on primary and secondary data.
The primary data is collected through interviews with experts of the field. These interviews highlight how longevity risk is tackled in a practical manner in the professional world and explain the specificity of the Swiss market.
Due to the complexity of the topic, most of the sources are coming from secondary data. The sources of secondary data are articles and books written by expert in longevity risk and pension funds. These documents allow to acquire a deep understanding of longevity risk and of the Swiss second pillar environment. This bachelor research also relied on statistical reports about the evolution of the Swiss population to have a wider understanding of the challenges related to longevity risk.

2. Background

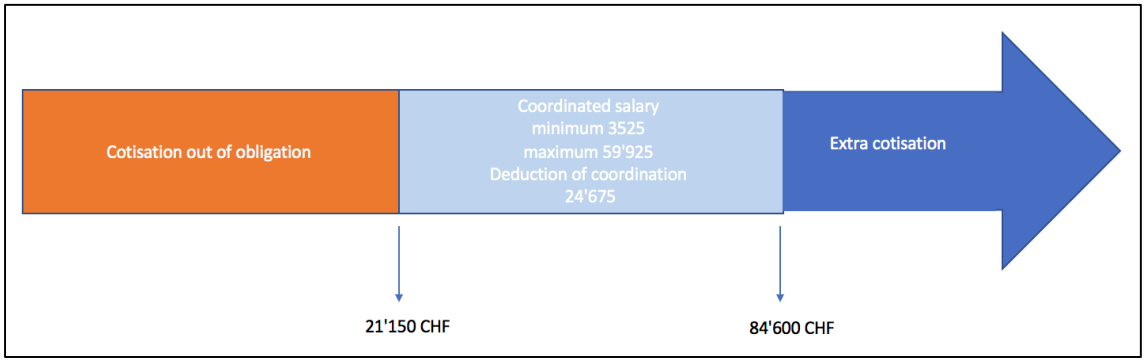
2.1 Swiss Pension Scheme System

The Swiss pension scheme system is constituted of 3 pillars. The first pillar also called the Assurance Vieillesse et Survivant (AVS) and the Assurance Invalidité (AI). It aims to provide an income, which guarantees a minimum level of living to retired and disabled people. This pillar is based on the principle of solidarity and on the pay-as-you-go system. This implies that the population aged between 21 and 64/65 (women/men) years old finances the actual rents of the beneficiaries. According to the OASI Law (Old Age Survivor Insurance), the people aged as of 17 who work must also contribute to the first pillar. Another sign of solidarity is that the level of contributions varies much more than the level of the rents (Durand, Gaille 2013). Indeed, an employee contributes 5.15% of his salary to the AVS/AI and APG (Assurance Pertes de Gains). However, the maximum complete rent for an individual is 2'350 CHF and the minimum is 1'175 CHF (Centre d'information AVS/AI, Office fédéral des assurances social et secrétariat d'Etat à l'économie 2017). The actual contributors will receive their future rents thanks to the next generations. The first pillar is mandatory and everyone must contribute to it.

The goal of the second pillar or Prévoyance Professionnelle when associated with the first pillar is to maintain the level of life at the age of retirement. Normally, a person who has contributed to the second pillar can expect around 60% of his last salary with the

first pillar included. The contribution to the second pillar is mandatory for all workers aged of minimum of 24 years old and who have an annual salary of at least 21'150 CHF. The contribution to the second pillar is based on the coordinated salary. This coordinated salary corresponds to the gross salary minus the part of the salary already insured by the 1st pillar. The part already insured is called the deduction of coordination. The second pillar is constituted of two parts the mandatory and the extra-mandatory. The mandatory part includes annual coordinated salaries between 3'525 and 59'925 CHF. The extra-mandatory part includes the additional part of the coordinated salary.

Figure 1 The coordinated salary



The second pillar is financed by the employee during all his professional life and by his employers. This period is called the accumulation phase. Regarding the mandatory part, the employer is forced by law to contribute at least to the same amount as its employees. Both contributions go to an independent third party (pension fund), which manages the contributions to guarantee a future level of rent. The maximum salary insured by the second pillar is 84'600 CHF annually. This amount corresponds to a coordinated salary of 59'925 CHF. The amount of 84'600 CHF corresponds to the salary ceiling, which must be insured by the second pillar. Nevertheless, many pension funds also insure part of the salary, which exceeds that amount.

The minimum level of contributions (mandatory part) evolves with the time according to the following table:

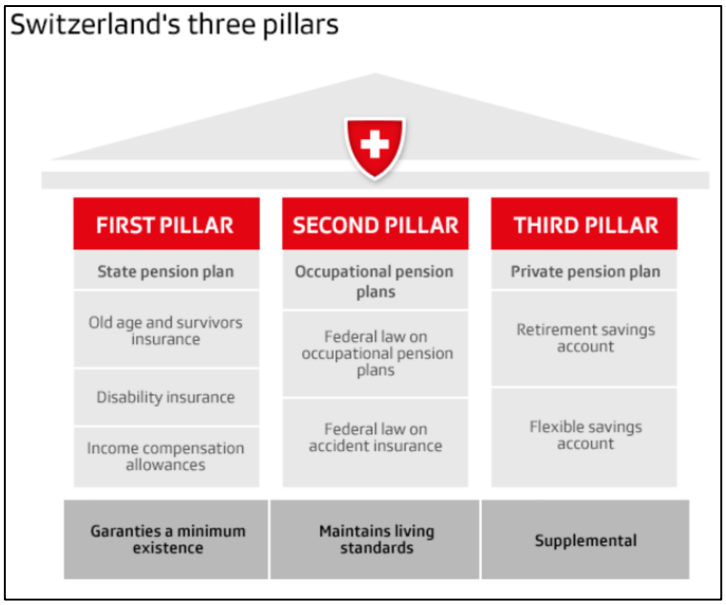
Figure 2 Minimum contributions to the second pillar

Age	Rate in % of the coordinated salary
25-34	7%
35-44	10%
45-54	15%
55-64 women	18%
55-65 men	18%

(Office fédéral des assurances sociales 2017)

Finally, the third pillar called the Prévoyance Individuelle is facultative. It is a private pension scheme, where people contribute according to their needs. The future beneficiary is the only contributor of that pillar. The Swiss Confederation promotes this kind of savings by enabling the insured people to deduct their contributions from their taxes (Centre d'information AVS/AI, Office fédéral des assurances social et secrétariat d'Etat à l'économie 2017).

Figure 3 The Swiss pension scheme system



(Jorio 2017)

2.2 The occupational plan of the second pillar

There are two distinct systems of occupational plans proposed by Swiss pension funds regarding the annuities of the second pillar. The first system is called a 'defined benefit' plan. A person who has contributed to the second pillar with a defined benefit plan receives a fixed percentage of his last salary. The importance of this part depends on the capital invested during the working life (Jorio 2017). The second system of occupational plans is a combination of a defined contribution plan and a defined benefit plan. This plan is based on a conversion rate fixed by law. Nowadays, this rate is 6.8%. The annuitant will perceive in the worst case a yearly rent equivalent to the percentage (rate) of the capital that he has been invested during his working life (minimum defined benefit part). If the placements made by the pension funds yield high returns, the annuitant might benefit of higher rents [defined contribution part] (Durand, Gaille 2013). It is worthwhile to explain that this conversion rate of 6.8% is applicable only to the mandatory part of the capital invested by the annuitant and his employers. Pension funds can adapt the conversion rate for the extra-mandatory part. For example, the Retraites Populaires used to provide the same conversion rate (6.8%) for the mandatory and for the extra-mandatory parts until 2016 but in 2017, the organization changed its policy and started to apply different conversion rates for the extra-mandatory part. Indeed, for the additional contributions, other conversions rates are used according to the choice of pension funds. Pension funds have different conversion rates for the extra-mandatory part as they do not provide annuities to the same population and consequently face different level of longevity risk. Nevertheless, all the conversion rates of the extra-mandatory part are currently decreasing. For example, as mentioned earlier, The Retraites Populaires has set up a planning about the decrease of its conversion rate for the extra-mandatory part. This rate will finally reach 6% in 2020 (Retraites populaires 2018).

Figure 4 Conversion rates for additional contributions at Retraites Populaires

Age	until 2016	2017	2018	2019	2020
Women of 64	6.800%	6.592%	6.392%	6.195%	6.000%
Men of 65	6.800%	6.584%	6.391%	6.187%	6.000%

(Retraites populaires 2018)

Example of a rent with a combined occupational plan at Retraites Populaires, which has additional contributions in 2020:

Figure 5 Example combined occupational plan for 2020

	Capital	Conversion rate	Annual annuity
Mandatory contributions	240'000	6.80%	16'320
Additional contributions	160'000	6%	9'600
Total	400'000		25'920

(Retraites populaires 2018)

The combined occupational plan is less risky for pension funds. They need to guarantee with their investments only the minimum level of rents set up by the conversion rate. While with a defined benefit plan pension the rents that must be financed are much more important. Indeed, defined benefit plans do not take into account the situation of financial markets as their level of annuities are fixed ahead of time.

2.3 The reallocation of the second pillar

Nowadays, people have the right at the time of retirement to take a part of their capital as a lump sum. If a beneficiary decides to withdraw a part of his second pillar, he has to take at least 25% of the capital. (Zimmermann 2017)

It is also possible to reallocate (taking cash) fully (mandatory and extra-mandatory parts) the second pillar under three circumstances: Purchasing a housing, launching an independent business and leaving definitely the country. However, there are some restrictions for each case.

Purchasing a housing restrictions:

- A withdrawal can be asked every five years
- Until 50 years old the full capital can be withdrawn. After 50 years, old only a small portion of the capital can be withdrawn
- When married you must have a written agreement of your partner
- If you sell the housing you must in most of the cases reimburse the capital touched

Launching an independent business:

- Proving that you are launching your activity by showing rent, material documents, the confirmation of the AVS, the inscription of the Commercial Register
- The request of withdrawing must be done the following year after the beginning of the activity.
- When married you must have a written agreement of your partner

Leaving definitely the country:

- To reallocate the full second pension fund before retirement you must go to another place than the European Union and the European Free Trade Association

If you go to one of these places only the extra-mandatory part can be withdrawn and the mandatory capital will be available at the time of retirement (Les authorités Suisse en ligne [no date]).

During the redaction of this paper, there were political discussions about changing the rules regarding the reallocation of the second pillar. Indeed, The Federal Council and the Council of States had voted in favor of the reform of the supplementary benefit (Prestation Complémentaires PCs). This reform redefined the framework of the allocations and of the reallocations of the second pillar.

The reform would impact the second pillar in the following ways:

- Impossibility to lump sum the mandatory capital (withdraw). The only exception is for the independents.

This exception was voted by the States Council. The Federal Council was in favor of forbidding to everyone to lump sum the mandatory capital of the second pillar (Agence télégraphique Suisse SA 2017).

The goal of this reform was to reduce the expenses of the PCs, which are booming. Between 2000 and 2016, the expenses linked to the PCs have more than doubled, from 2.3 billion to 4.9 billion per year (Office fédéral des assurances sociales 2018). Nevertheless, to be implemented the reform needed the approval of the National Council. The National Council looked at that matter and took a decision during the Spring session 2018 (Csss-n Commissions de la sécurité sociale et de la santé publique).

During that session, the National Council refused to accept the measure about the impossibility to withdraw the mandatory capital. The chamber wants to keep the actual legislation about the secondary pillar. It is interesting to observe that the politicians of the National Council are trying to preserve a level of freedom to the population about the management of its second pillar. At that moment May 2018, the commission in charge of that matter, is working on future proposals to the States Council. However, this commission has the same point of view as the National Council. Therefore, there are high probabilities that the reform will not impact the reallocation of the capital.

If this measure was accepted, it would have impacted the pension funds, in the sense that the number of people perceiving annuities would have increased. This would have automatically led to an increase in longevity risk for pension funds. Indeed, when an individual decides to withdraw his capital, there is a transfer of longevity risk from the pension fund to the beneficiary. It is essential to understand that when an individual decides to withdraw his capital, he also accepts to bear on his own the longevity risk. His pension fund does not have to provide annuities and consequently does not bear the longevity risk of this individual. People tend to believe wrongly that the withdrawals of capitals put their pension funds in difficulty. However, a pension fund can be better off if

an individual with a truly long life decided to take a lump sum his second pillar. Indeed, the total of annuities paid to this person would have been more important than the capital cash out by the pension fund. In addition to that, the pension fund does not have the responsibility to make the right investments to guarantee the rent of this individual.

2.4 Pension Funds in Switzerland

Figure 6 The different kinds of pension funds in Switzerland

IP percentages by risk cover in 2016

Independent	39.5%
Semi-independent	53.0%
Collective	7.0%
Savings scheme	0.5%

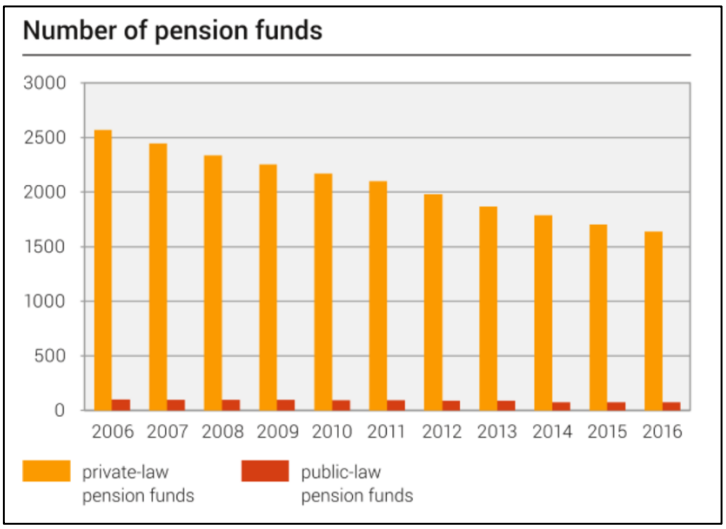
(Office fédéral de la statistique 2017a)

The abbreviation IP in the figure means Institution de Prévoyance. In Switzerland, it exists three main kinds of pension funds. All these kinds of pension funds could potentially be interested in transferring a part of their longevity risk to third parties.

- Independent pension fund are organizations, which manages by themselves all the contributions for the 2nd pillar of companies and bear the risks associated with their occupational pension plans.
- Semi-independent pension funds are organization, which manages by themselves the occupational pensions plans of companies but transfer some of the risks associated to their activities to insurances or reinsurance companies.
- Collective pension funds are organizations, which associate wide pools of independent workers and manage their contribution to their second pillar and propose them different occupational pension plans according to their contribution. Collective pension funds can be independent (most of the time) or semi-independent.
- Savings schemes (institution d'épargne) are banks or insurance companies, which propose some placements that guarantee future interests (Profond institution of prevoyance 2017).

In Switzerland, the number of Swiss pension funds is decreasing drastically. Indeed in 1985 the country counted around 18'000 pension funds, whereas in 2015 this number was divided by 9 (Jeannerat 2015). There are two main reasons to explain this phenomenon. Firstly, many companies start to prefer focusing on their operational activities rather than managing an independent pension funds. The managers of independent pension funds are getting retired and not many people are interested in retaking these activities. Secondly, there is the economy of scale. "the economic efficiency is 5 billion of asset per pension fund or between 30'000 and 40'000 insured" (Garessus 2016).

Figure 7 Number of pension funds



(Office fédéral de la statistique 2017a)

2.5 How does a pension fund work?

A pension fund perceives contributions from employees and employers. The institution invests this money into different investments such as properties, State bonds, securities, etc. The pension funds also finance themselves thanks to the interests they perceived. By managing effectively its portfolio a pension fund can finance occupational pension plans to employees and thus, guarantee them a good quality of life once retired. The period of contribution of an employee is called the accumulation period. During this period, pension funds have the responsibility to generate the minimum profit set up by the Swiss Confederation. The Government defines the level of profit according to the shape of the financial market. Since 2017, The Swiss pension funds must generate a profit of at least 1% on their total investments. During the last decade, The Swiss Government has steadily decreased this level of return expected from pension funds.

This is due to the historically low interest rates and the poor performances of the share market (Office fédéral des assurances sociales 2016).

La loi sur la Prévoyance Professionnelle et l'Ordonnance Fédérale sur la Prévoyance Professionnelle Vieillesse Survivant et Invaliditité provides the legal framework to pension funds. This legal framework aims to minimize the financial risk linked to the market and to enable pension funds to have enough flexibility to guarantee the financing of their occupational pension plans. To be seen as safe a pension fund requires to make profit in the short, medium and long term.

The article 53 of the Ordonnance Féderale defines what are the categories of placements allowed for the pension funds:

A. Currencies

B. Assets and receivables of the following types:

    1. Holdings on post or bank accounts
    2. Placements on currency markets with a maturity of maximum 12 months
    3. Cash certificates
    4. Lending bonds included convertible bonds
    5. Bonds of indemnity
    6. Mortgages Swiss titles
    7. Acknowledgment of debts
    8. Value of repurchase of insurance contracts

C. Properties (Real estate)

D. Shares and securities

E. Alternative placements (hedge funds, private equity, insurance linked securities)

The article 55 of the Ordonnance Féderale defines the maximum limits of investment per category.

A. 50% in Swiss mortgages titles

B. 50% in stocks

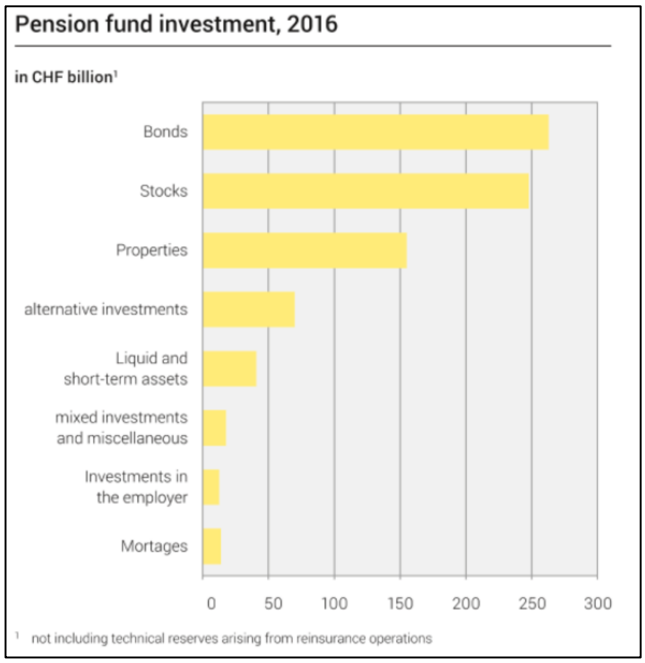
C. 30% in properties (Real estate) with a maximum of 1/3 abroad

D. 15% in alternative placements

E. 30% in foreign currencies (without hedging against the exchange risk)

(Ordonnance sur la prévoyance professionnelle vieillesse, survivants et invalidité)

Figure 8 The investment of the Swiss pension funds in 2016

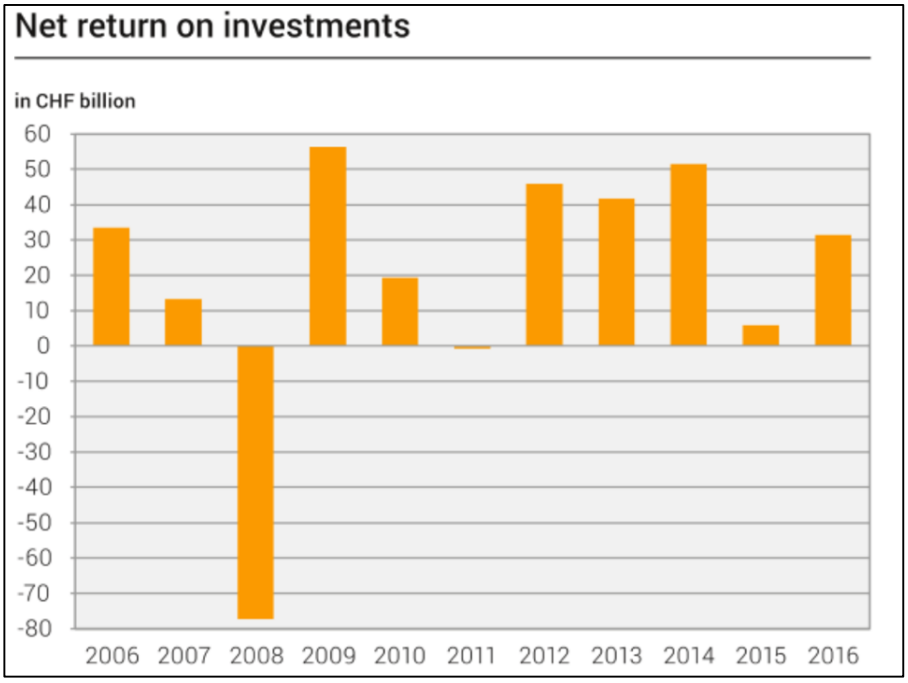


(Office fédéral de la statistique 2017b)

The article 56a of the Ordonnance Féderale explains that pension funds have the right to invest into financial derivatives if:

- They are associated with the investment mentioned under the article 53.
- Solvability of the counterparty and the negotiation must be considered for each financial instrument
- Each operation with a standard derivative must be hedged
- The use of financial derivatives must be hedged
- The use of financial derivatives must not have a leverage effect on the global wealth
- The limits under articles 54, 54a, 54b, 55 must be respected

Figure 9 Net return on investments for Swiss pension funds



(Office fédéral de la statistique 2017c)

In this graph, we can observe that the overall net return on investment for pension funds have been truly variable between 2006 and 2016. Nevertheless, we can observe that only in 2008 and 2011 Swiss pension funds experienced losses. The terrible performance of 2008 (loss close to 80 billion CHF) is due to the subprime financial crisis, which led the collapse of the economy. In 2011, the loss is explained by the poor return of the share market.

A pension fund is considered to have sufficient financial stability when its funding ratio is above 100% (Axa Winterthur 2016).

The funding ratio: Available amount of stable funding / Required amount of stable funding (Basel3 committee on banking supervision 2014).

A pension fund knows exactly its available amount of stable funding, which corresponds to its whole portfolios invested. What is complicated is to define is the required amount of stable funding. The required amount of stable funding relies on the life expectancy of the annuitants. A pension fund makes several scenarios regarding this life expectancy to have an idea on how much return they should make from their investments to guarantee their occupational plans. The problem is that during many years, pension funds through their scenarios have underestimated the life expectancy of their annuitants and thus, have provided too high annuities. The technical rate is used to measure the

actual value of the commitments made by a pension fund. This rate must reflect a long-term average of the future return expected on the financial market. There are two parameters that have truly an impact on that rate, the investment strategy and the capacity to bear risk. The projected performance in the long term of the different investments is the basis to compute this technical rate (Welsch 2011). Each pension fund defines on its own its technical rate but they must comply with the legislation. Most of the pension funds have the same technical rate as they face similar challenges. La Chambre Suisse des Experts en Caisse de pension determines a reference rate every year. The actual reference rate is of 2% fixed in September 2017. The technical rate is also used to define the evolution of the future occupation plans made by pension funds.

The main challenges for a pension fund are the following:

- Estimate the life expectancy of its annuitants
- Estimate what profits should be generated by its portfolio to cover the pension payouts from its occupational pension plans
- Investing in the right assets, which provide these profits
- Complying with the legal framework of the Swiss Confederation
- Providing coherent occupational pension plans

2.6 Evolution of the Swiss population and of its life expectancy

The Swiss population is getting more ageing. In 1900, the proportion of people aged below 20 years old was 40.7% of the total Swiss population, whereas in 2016, this percentage was of 20.1%. In contrast, the proportion of people aged over 60 years old has increased significantly from 5.8% to 18.1% of the total Swiss population (Office fédéral de la statistique 2018).

The Swiss population is getting more ageing for the following reasons:

- Switzerland is experiencing historically low birth rates
- The overall improvement in the conditions of life
- The improvement in medicine and in the healthcare system

It is based on these factors that the OFS made different hypothesis and scenarios about the evolution of the life expectancy in Switzerland.

The Swiss Federal Office Federal Swiss of the statistic currently studies the evolution of the Swiss population and tries to have a clear idea on its main changes. In 2015, the office did a full analysis of the evolution of the Swiss population until 2045. This analysis is constituted on three probable scenarios:

- The reference scenario (scenario A) is based on the prolongation of trends observed during the last years.
- The high range scenario (scenario B) is based on more favorable hypothesis about the demographic growth of the country.
- The low range scenario (scenario C) is based on less favorable hypothesis about the demographic growth of the country

All these scenarios project an increase in the life expectancy of the Swiss population. The real question to answer for pension funds is of how much it will. The Swiss population defines in these scenarios is:

- The people who have the Swiss nationality and have their place of residence in Switzerland.
- The foreigners who have obtained an authorization of living in the country for at least 12 months.
- The foreigners who have cumulated several short-term authorizations of living in the country (at least 12 months).
- People who are in asylum in Switzerland for at least 12 months.

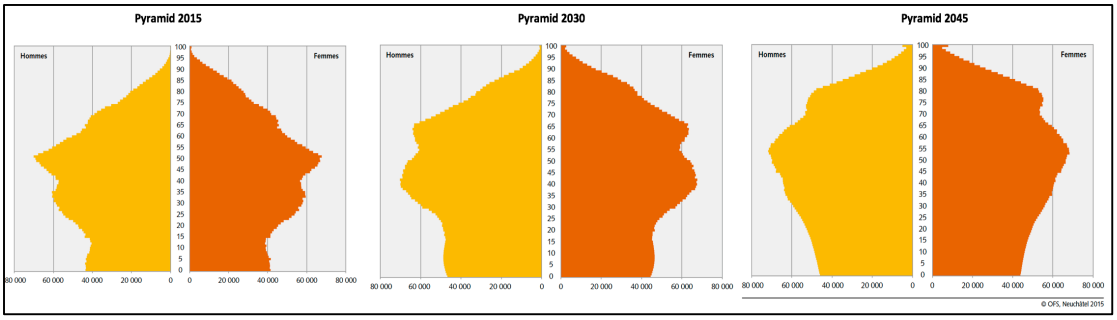
Some graphs and numbers about the scenario A of reference

Figure 10 Evolution of the Swiss population A

	Evolution of the Swiss population A			
	Years	2015	2030	2045
	Population of 65 or over years old	1.5 million	2.2 million	2.7 million
	Percentage of people aged of 65 or over for 100 people aged between 20 and 64 years old	29.10%	39.60%	48.10%
	Percentage of children and young adult under 20 years old	20.00%	19.70%	18.60%
Hypothesis	Life expectancy for a girl born (in years)	85.1	87.6	89.4
	Life expectancy for a boy born (in years)	81.2	84.2	86.2
	Remaing years of life for a woman aged of 65 years old in	22.4	24.4	25.9
	Remaing years of life for a man aged of 65 years old in	19.6	21.8	23.5

(Based on : Office fédéral de la statistique 2015)

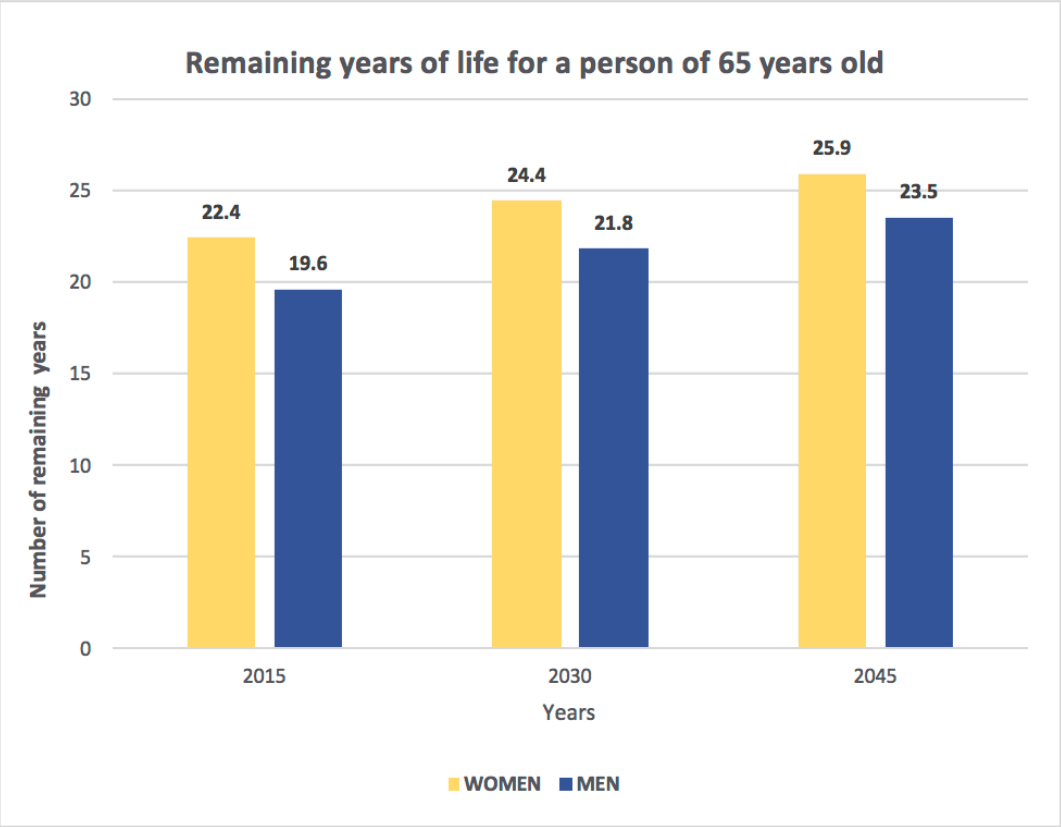
Figure 11 Evolution of the pyramid of age between 2015 and 2045 according to scenario A



(Office fédéral de la statistique 2015)

These pyramids allow us to visualize the increase in age of the Swiss population. We can truly see that in 2045 the pyramid has more the shape of a spin than a pyramid as the proportion of elderly people is getting more and more significant within the Swiss population.

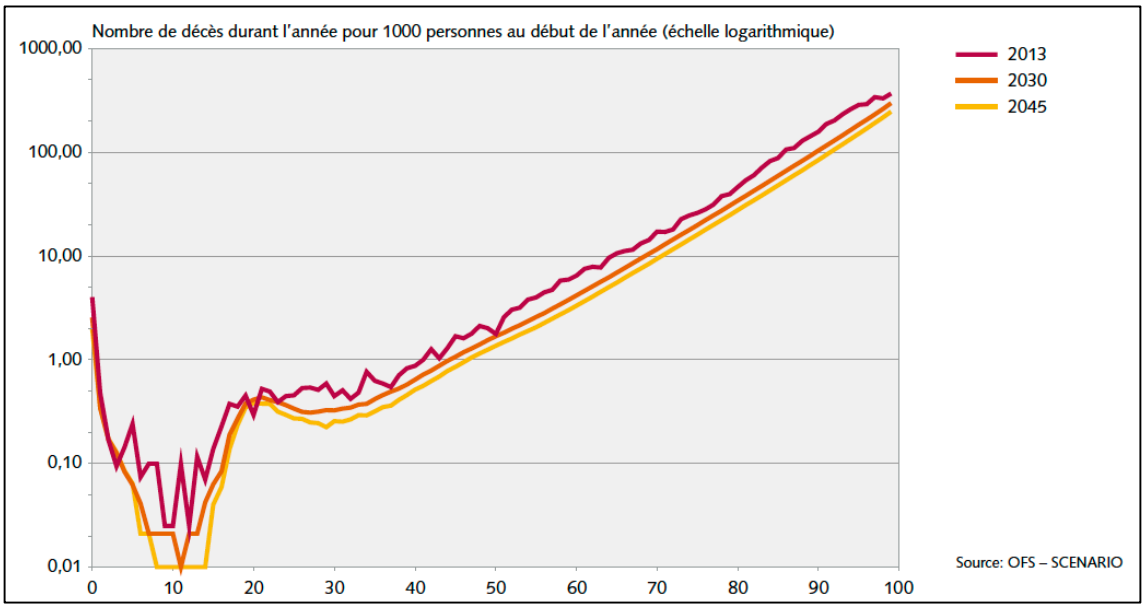
Figure 12 Remaining years of life between 2015 and 2045



(Based on : Office fédéral de la statistique 2015)

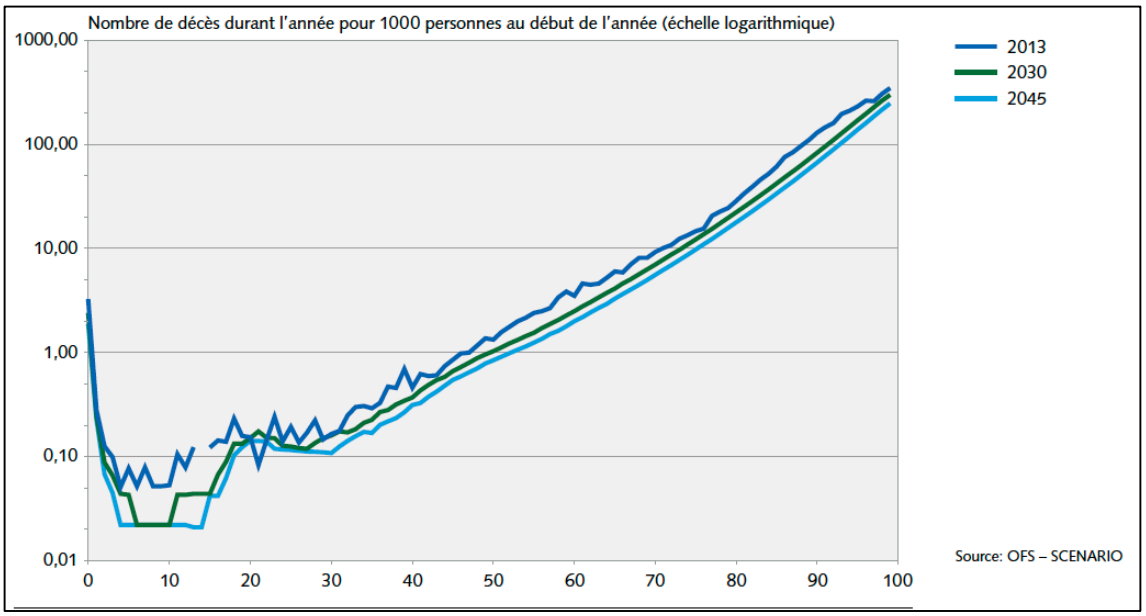
These numbers are essential for pension funds because they enable them to make predictions about the total cash out of their occupational plans. We can see that a pension fund should provide 3.9 additional years of annuities for a man who will start his retirement in 2045 than for a man who started his retirement in 2015. This phenomenon is exactly the same for women. This trend of having retired people living longer has a direct impact on pension funds, which have to pay more annuities. In the long-run, this trend forces the pension funds to reduce their commitments regarding their occupational pension plans. As the overall increases in the life expectancy makes their occupational plans to expensive and cash intensive.

Figure 13 The number of deaths during 1 year for 1000 men per age (logarithm scale)



(Office fédéral de la statistique 2015)

Figure 14 The number of deaths during 1 year for 1000 women per age (logarithm scale)

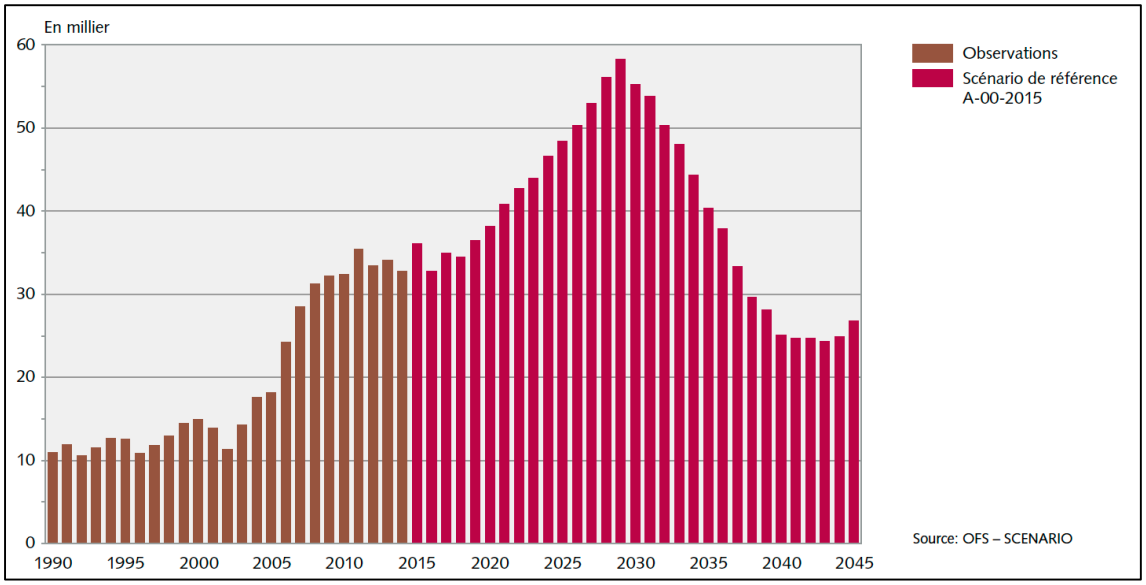


(Office fédéral de la statistique 2015)

These mortality rates show that the number of deaths decrease through the time. This implies that people will carry on living longer. These mortality rates are fundamental for pension funds and the providers of long-term financial derivative instruments (investment

banks, insurance and reinsurance companies). Indeed, they are used to create survival-indexes. The goal of these survival-indexes is to model the longevity risk for a specific population.

Figure 15 Annual increase in the permanent resident population aged 65 or over until 2045

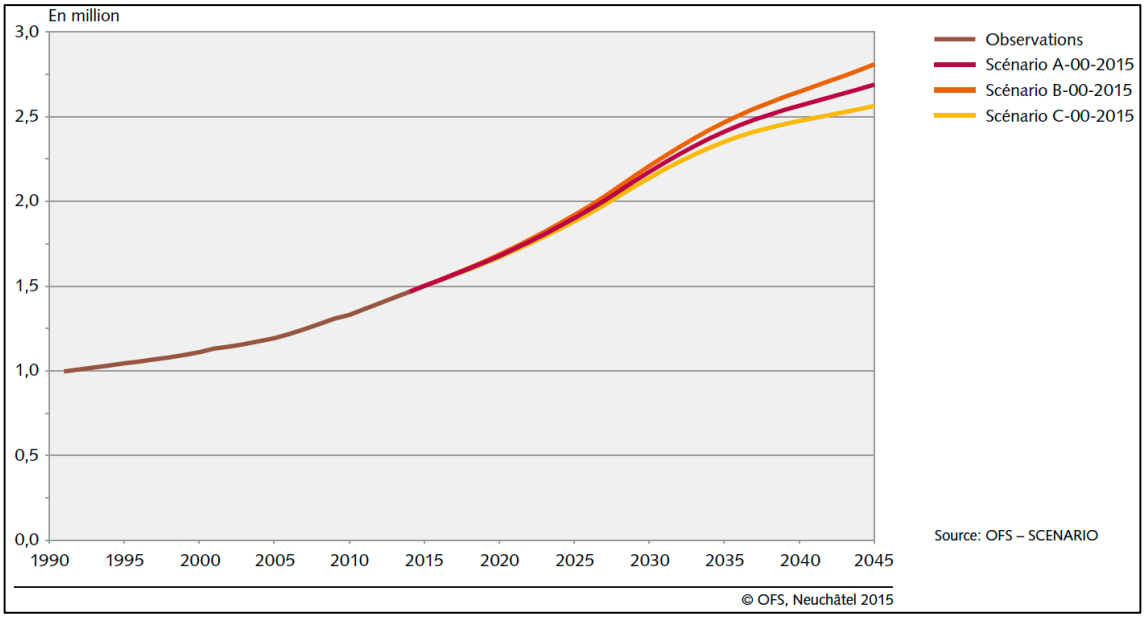


(Office fédéral de la statistique 2015)

In this graph, we can observe the increase in number of people aged 65 and over. This increase will be important until 2030 and it will continue to a lesser extend after that year. This significant increase is due to the baby boom. It is important to understand that even when all the baby boomers will reach the age of 65 years old, the proportion of Swiss people aged of 65 years old or over will continue to grow.

Some graphs and numbers about the three scenarios

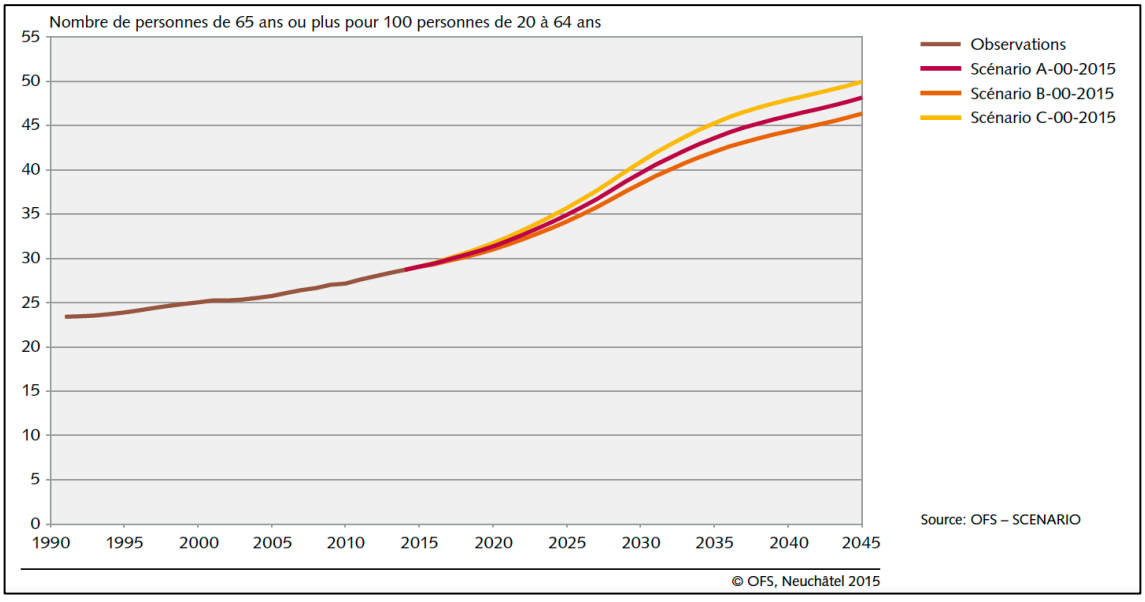
Figure 16 Evolution of the population aged 65 years or over until 2045



(Office fédéral de la statistique 2015)

This graph allows us to understand that regardless the scenario we analyse the number of people aged of 65 years old or over will keep increase through the time and will pass the threshold of 2.5 million before 2045. Thus, the Swiss population getting ageing is not a simple conclusion of a scenario but a clear fact.

Figure 17 Percentage of people aged 65 or over for 100 people aged between 20 and 64 years old



(Office fédéral de la statistique 2015)

This graph is truly relevant for the 1st pillar of the Swiss pension scheme system. As it shows for each scenario that the ratio of dependency between the "supposed retired people" and the "supposed active generation" is currently increasing. The first pillar is based on the principle of solidarity (active people must finance the rents of the retired people), this increase in dependency puts the system at risk. Indeed, an active person must bear more and more cost. The scenario of reference A presents the following figures: in 2015, we counted 29 rents for 100 actives, in 2030 the number of rents for 100 actives will almost reach 40 and finally in 2045, the number of rents for 100 actives will reach 48 (Office fédéral de la statistique 2015).

3. Analysis

3.1 Longevity risk

In this paper longevity risk is: the risk that populations live longer than expected in comparison with the estimations made by pension funds.

It is essential to understand that the longevity risk impacts many different actors such as governments, pension funds, individuals, private companies, investment banks, insurance and reinsurance companies.

One on side we have the actors who currently bear the risks, pension funds, governments, individuals and private companies. On the other side, we have some actors: investment banks, insurances and reinsurances companies, who might be willing to bear some of the longevity risk in the future by proposing long-term financial derivative instruments such as Q-forward contracts, Swaps and Longevity Bonds. In several countries (United-Kingdom, Canada, United-States, Australia and Chile), the use of these instruments is getting common to mitigate the longevity risk.

3.2 Micro and Macro longevity risk

Experts use various statistic models to measure and understand the risk of longevity. In statistic, it exists two categories of longevity risk the Micro-longevity risk and the Macro-longevity risk. "Micro-longevity risk quantifies the risk related to uncertainty in the time of death if survival probabilities are known with certainty, while Macro-longevity risk is due to uncertain future survival probabilities" (Hari, De Waegenaere, Nijman 2007). Studies have revealed that the Micro-longevity is not significant for pension funds as they have huge pools of annuitants. Thanks to these pools the standard deviation of the time of death decreases significantly and becomes almost equal to the expected value of the

time of death. So, the pension funds are able to predict accurately for a specific pool of its annuitants when the time of death will occur. The Macro-longevity is much more problematic. Studies have revealed that Macro-longevity risk is independent of the portfolio size (Hari, De Waegenaere, Nijman 2007). Nowadays, we do not have the instruments to measure efficiently the Macro-longevity risk. This implies that the future survival probabilities are truly uncertain. This is problematic for pension funds, which must propose relevant future occupational plans for the active workforce.

3.3 The actors affected by the longevity risk

3.3.1 Pension funds

The most critical consequence of the longevity risk is that pension funds becomes underfunded and could no longer face their obligations to finance their occupational pension plans. This means their impossibility to pay the annuities to retired people.

3.3.2 Governments

Governments bear the risk to support inactive elderly people who fall into the welfare system due to their vanishing capitals and their impossibilities to maintain a decent level of life. Governments might also have to bail out public pensions funds, which cannot carry on facing the costs of their occupational benefit plans. Moreover, Governments could have to provide directly funds to individuals due to the “bankruptcies” of pension funds. Indeed, Governments are employers of many people. Thus, they are liable for the occupational plans of their employees.

3.3.3 Individuals

Individuals bear the risk of not managing efficiently their second pillar. The longevity risk can have a direct impact on individuals. When an individual decides to lump sum the full amount of his second pillar instead of receiving monthly annuities. If this person spends its entire capital before his death, he will be in a financial distress (Courbage 2014). Individuals might also not receive their full future annuities due to a lack of cash-flows of pension funds. Moreover, individuals also pay the consequences when a State pension funds required additional funds. In that case, the government bails out the pension funds but this cost has inevitably an impact on taxpayers.

3.3.4 Private companies

Private companies are affected by longevity risk. In the case, where the pension fund of a private company has some difficulty to finance its occupational pension plans, the company has to increase its contribution to the fund. Moreover, if a pension fund proposes uninteresting occupational pension plans due to longevity risk, the private companies associate to this pension fund might have some difficulties to hire or retain talented workers.

Figure 18 The different effect of longevity risk

	Pension Funds	Governments	Individuals	Private companies
Insolvency of occupational benefit plans	X		X	X
Bail out pension funds		X	X	X
Providing funds to individuals		X		
Managing personal capital			X	
"Bankruptcy" of pension funds	X	X	X	X

3.4 Models to measure life expectancy

Actuaries have been trying to forecast the changes in future life expectancies by using extrapolations methods for decades (Lee 2000). Their goal is to define accurately these changes and their intrinsic challenges in order to enable the society to respond to them. Here, the society is referred as people, governments, pension funds, private companies, investment banks, insurance and reinsurance companies. The problem is that at the moment, actuaries cannot guarantee the viability of these models in the long-run. This is explainable because these models rely mainly on historical data such as tables of mortality. The pattern of previous years might not match with the future. For instance, the actual models are not able to measure the impacts linked to the improvement of the medicine or the changes in lifestyle. They also might miss the appearance of new epidemics or diseases. Nevertheless, the Lee-Carter model proposed excellent forecast for the period 1900-1990. Thanks to the similarities in the life patterns during this period. The Lee-Carter model did not meet the same success for previous periods because the trends in our time-varying parameters was not linear (Lee 2000). The important thing to keep in mind is that actuaries are constantly improving their models and affine their forecasts. Before the apparition of these models, pension funds had to propose occupational pension plans without having clear ideas about the life expectancies of their

annuitants. This has led them to provide over-optimistic rents and therefore decouple their longevity risk. It is correct that actual models are not perfect instruments that can underestimate life expectancies and create longevity risk but they allow pension funds to have a much greater visibility and a deeper understanding of longevity risk.

3.4.1 Lee-Carter model

"In 1992, Lee and Carter published a new method for long-run forecasts of the level and age pattern of mortality, based on a combination of statistical time series methods and a simple approach to dealing with the age distribution of mortality" (Lee 2000).

The Lee-Carter model is based on a stochastic process. This stochastic process enables to model the uncertainty about the future. This model has been widely used by actuaries. Moreover, many extended versions of the Lee-Carter were made like the Renshaw-Haberman Model.

The model : (Lee 2000)

$$\ln(m_{x,t}) = a_x + b_x k_t + e_{x,t}$$

- m_{xt} central death rate for age x
- a_x coefficient describes the average shape of the age profile
- b_x coefficient describe the pattern of deviation from this age profile when the parameter K varies.
- k_t tracks mortality changes over times
- e_{xt} error terms

3.5 Survival indexes

Survival indexes are used to propose long-term financial derivative instruments. They have a key role to play in the elaboration of these instruments. The goal of survival indexes is to determine the future cash requirements of occupational pension plans. This is key to determine because it enables pension funds, investment banks, insurance and reinsurance companies to set prices of financial derivative instruments. It is obvious that before accepting to propose any solutions to the markets, providers of financial derivative instruments (investment banks, insurance and reinsurance companies) want to know the costs and the risks of bearing a part of pension funds' longevity risk. A survival index contains many information regarding a defined population. Indeed, it provides central

rates of mortality and life expectancies per age and gender (Life and Longevity Market Association 2012). All these pieces of information are parameters that influence the price of financial instruments. These indexes rely on historical data. Having efficient survival indexes give some guarantees to investors because it leads to more liquidity on the market. This means that in the case where an investor wants to get out of the deal and exchange his instrument with another party, he will be able to do it more easily. In addition to that, the survival indexes can have another function. The pension funds can compare them with their own internal projections regarding the evolution of the life expectancy. This enables them to see if their strategies about their occupational pension plans are in adequacy with the financial market (Barrieu et al. 2010).

3.6 Life and Longevity Market Association

The Life and Longevity Market Association (LLMA) is a not-for-profit joint-venture created in 2010. The current members of this venture are AVIVA, AXA, Deutsche Bank, J.P. Morgan, Morgan Stanley, Prudential PLC and Swiss Re. The goal of its venture is to provide a well-defined framework to enhance the liquidity and the marketability of long-term financial derivatives to mitigate the longevity risk.
More precisely, the LLMA sets up standards and conventions to enable consistency, transparency and thus liquidity between the financial instruments proposed by the different providers (investment banks and insurance/reinsurance companies). In order to do that the LLMA defines the methods and the rules used to build survival indexes on which rely long-term financial derivative instruments. The LLMA has already created few indexes for different countries to respond to the need of their specific markets.

LLMA Indexes:

- LLMA longevity index for England and Wales
- LLMA longevity index for Germany
- LLMA longevity index for Netherlands
- LLMA longevity index for USA

These indexes are the benchmarks of the longevity market. This is explainable by the fact that major players of the longevity market are involved in the LLMA. The LLMA has created a guideline to guarantee the success of new indexes. This guideline defines the key factors for a survival index. Moreover, it provides different process and goal for each of these factors (Life and Longevity Market Association 2012).

The key factors for a survival index are the followings:

- Tradability of the index
- Transparency of the index
- Robustness
- Objectivity
- Simplicity
- Clear Governance
- Timeliness
- Continuity
- Consistency
- Universality

In addition to its guideline the LLMA has also defined three essential features of an index.

- The underlying population of the index
    - Must be accurate and defined
- The body of mortality data associated with that population
    - Must come from reliable source and be of high quality
- The index methodology
    - Should be generalized and applicable to different populations to increase the standardization and thus the understanding of the market participants

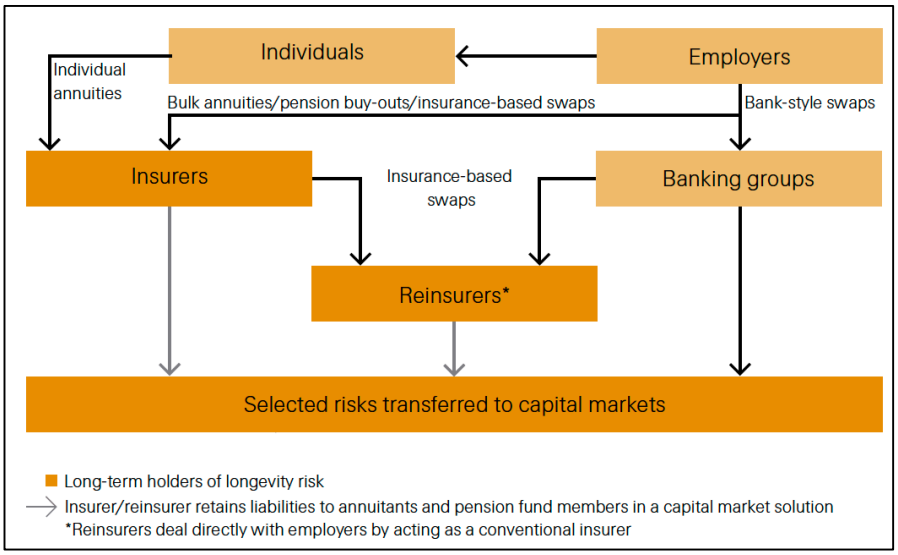
Clear survival indexes are required to develop the liquidity of a market without them nobody would exchange these instruments by not understanding them and by not knowing on what they rely (Life and Longevity Market Association 2012).

3.7 Main actors proposing solutions against longevity risk

As mentioned several times in this paper investment banks, insurance and reinsurance companies are natural providers of solutions to transfer longevity risk. However, their capacity to bear longevity risk is limited. This limitation is due to several factors such as the increasing nature of longevity risk and the capital requirements regulations of these institutions (Mcmullan, Wolomglewicz, Singleton 2012).
For this reason, the providers of these instruments are trying to develop a capital market for longevity risk. The goal of this capital market is to enable investors to trade long-term financial derivative instruments. The participations of external investors will multiply the

overall capacity of transferring longevity risk. However, they are many challenges related to the development of a longevity capital market. It is fundamental to develop the awareness of these instruments to potential investors and explain them in what they could be interesting for them. The main advantage of the derivative instruments used to transfer longevity risk is that they are truly uncorrelated with the risks of typical financial instruments. So, it enables investors to diversify their portfolios. Regarding the development of the capital market of longevity, it is also essential to carry on developing external organizations such as the Life and Longevity Market Association. These organizations enable the standardization and the transparency of financial instruments and the development of the longevity capital market. Without them nobody will dare investing in such derivative instruments. Investors must see the reliability of the survival index on which the financial instrument is built. Moreover, investors look for the liquidity of these instruments on the market because they do not want to be completely stuck in their commitments. External organizations like the Life and Longevity Market Association respond to that need by standardizing the market. The governments also have a big role to play in the development of this capital market. They have to provide information of high quality about the evolution of their populations. Governments have the high responsibility to produce high primary quality data because it is thanks to these pieces of information that the different actors can measure the longevity risk of a population and thus create trustful instruments (Mcmullan, Wolomglewicz, Singleton 2012).

Figure 19 Longevity de-risking strategies



(Singleton, Thomsen, Yiasoumi 2010)

In that figure, the pension funds are at the same place as the employers.

3.7.1 Insurance companies

The insurance companies involve in the life insurances markets invest massively in longevity risk. However, most of the insurance companies do not use directly financial derivative instruments with pension funds. It exists some exceptions like for instance Aviva Axa or Zurich. Usually insurance companies propose to bear the longevity risk of pension funds through buy-ins and buy-outs products or through swap out of money solutions. Insurance companies use financial derivatives with reinsurance companies to retransfer the longevity risk of pension funds but in that case, it is the reinsurance company that is the provider of the financial instrument. Most of the time insurers do not propose this kind of financial instruments because the construction of these derivative instruments is not in their core competencies. Moreover, the conceptions of these instruments are highly complex and require specific knowhow and a deep understanding of financial products. Nevertheless, this reality truly depends on countries. There are some markets like the United-Kingdom where insurance companies provide financial derivative instruments. In Switzerland, insurance companies have no incentive to start providing complex products such as longevity swaps or longevity bonds. The number of pension funds that might be interested in these kind of financial instruments is low. This is explainable by the fact that most of the Swiss pension funds transfer their risks via insurance products. In addition to that, small pension funds of fewer than 300 beneficiaries have the obligation to transfer their death and invalidity risks (Appendix 3 Interview Mr. Hostettler).

3.7.2 Investment banks

In contrast with insurance companies, investment banks have the full knowhow and the techniques to propose financial derivative instruments to pension funds but they face another problem in that market. Pension funds are more reluctant to enter in an agreement with an investment bank than with an insurance or a reinsurance company.
Insurance and reinsurance companies thanks to their activities are perceived as risk takers whereas investment banks are not. Investment banks retransfer directly longevity risk to reinsurance companies or to external investors. Investment banks are not long-term holders of longevity risk. This reality implies that investment banks are not the best positioned companies to bear longevity risk. Nevertheless, this kind of companies has an important role to play. This role is the development of a capital market for longevity risk in order to increase the overall capacity to transfer longevity risk (Singleton, Thomsen, Yiasoumi 2010).

3.7.3 Reinsurance companies

Reinsurance companies have an excellent position to provide long-term financial derivative instruments based on survivor indexes. First, this kind of companies beneficiate from their significant sizes and therefore, a higher capacity to bear longevity risk than insurance companies. Thanks to that reinsurance companies can provide relevant solutions to pension funds. One of the challenges related to longevity risk is the size of the pool of people insured. In addition to that, reinsurance companies like insurance companies are also intensively involve in the life insurance market. As explained in the interview with Mr. Klein (Appendix 2), the underlying risk of life insurances is the possibility to experience a significant increase in mortality. Longevity and mortality risk are opposite. This implies that a reinsurance could propose derivatives instruments to a pension funds in order to hedge its mortality risk. The only difficulty is that it is almost impossible to have a perfect hedge between both risks. A perfect hedge implies that the reinsurance companies should propose solutions to the occupational plans of its own life insurance customers.

Reinsurance companies are also indirectly involved in the transfer of longevity risk. Many insurances companies and investment banks retransfer a part of their longevity risk to reinsurance companies. Insurances companies and investment banks do that because it is irrelevant for them to bear the entire longevity risk of an occupational plan. Moreover, frequently small pension funds are not able to transfer directly their longevity risk to reinsurers because their pension schemes are not important enough. In that case, the small pension funds have to work with insurance companies. Finally, the reinsurance companies have for core business to diversify as much as they can the various risks and the use of these financial derivative instruments is an efficient technique do to it.

The following table shows the most important transfer of longevity risk in 2015. It is interesting to see that most of the providers are reinsurance companies.

Figure 20 Transfer of longevity risk in 2015

Fund/Sponsor	Provider(s)	Solution	Size	Date
Philips UK Pension Fund	Pension Ins Corp & Hannover Re	Buy-out & longevity reinsurance	£2.4 billion	Nov 2015
Newcastle Pension Plan	Friends Life plus Swiss Re	Longevity swap * reinsurance	£2.4 billion	Sep 2015
Legal & General	Prudential	Longevity reinsurance	£2.9 billion	Aug 2015
AEGON	Canada Life Re	Longevity swap & reinsurance	€6 billion	Jul 2015
AXA UK Pension Scheme	RGA Re	Longevity swap	£2.8 billion	Jul 2015
Pension Insurance Corp	Prudential Insurance Company of America	Longevity reinsurance	£1.6 billion	Jun 2015
Delta Lloyd	RGA Re	Index-based longevity derivative (swap)	€12 billion	Jun 2015
Bell Canada Pension Plan (BCE Inc.)	Sun Life Financial, SCOR & RGA Re	Longevity swap & reinsurance	CAD$5 billion	Mar 2015
Scottish Power	Abbey Life	Longevity swap	£2 billion	Feb 2015
MNOPF	Pacific Life Re	Longevity swap & reinsurance	£1.5 billion	Jan 2015

(Society of actuaries 2016)

3.8 Solvency II

Solvency II came from the directive 2009/138/EC of the European Parliament and of the Council. It was created to harmonize the legislation of the insurance and reinsurance sectors within the Union. Solvency II is now applied in the whole European Union. The directive was already discussed in the European Parliament before the financial crisis of 2008. However, the crisis has speeded up the implementation of the regulation. The politicians became more aware of the need of a tighter regulation in the insurance and reinsurance sectors after the crisis.

The Solvency II project has few key objectives:

- Improved consumer protections
- Modernized supervision
- Deepened EU market integration
- Increased international competitiveness of EU insurers (Lloyd's [no date])

Switzerland like the United-States and many other countries out of the European Union does not use the solvency framework. The country uses the Swiss Solvency Test to

assess the solvency of its insurances and reinsurances companies. Nevertheless, Switzerland has received an equivalence from the European Union for its Swiss Solvency Test. This equivalence determines that the system used in Switzerland is in adequacy with the requirements of solvency II

These regulations have an important impact on the financial derivative instruments that insurance and reinsurance companies could propose to pension funds. Indeed, these companies must comply with regulatory requirements imposed by these regulations. These requirements diminish their ability to bear longevity risk of pension funds.

Solvency II is built on three pillars:

- The first pillar defines the regulation about the financial requirements and is based on quantitative data. This pillar has defined two indicators to measure the solvency of insurance and reinsurance companies. These indicators are the Solvency Capital Requirements (SCR) and the Minimum Capital Requirement (MCR) (Solvency II association a [no date]).

  The SCR should show the ability of an insurance and reinsurance company to survive at tremendous losses. The goal is to guarantee to beneficiaries and policyholders that they will receive their money in case of major issues. “Solvency Capital Requirement should be determined as the economic capital to be held by insurance and reinsurance undertakings in order to ensure that ruin occurs no more often than once every 200 years” (Solvency II association a [no date]).

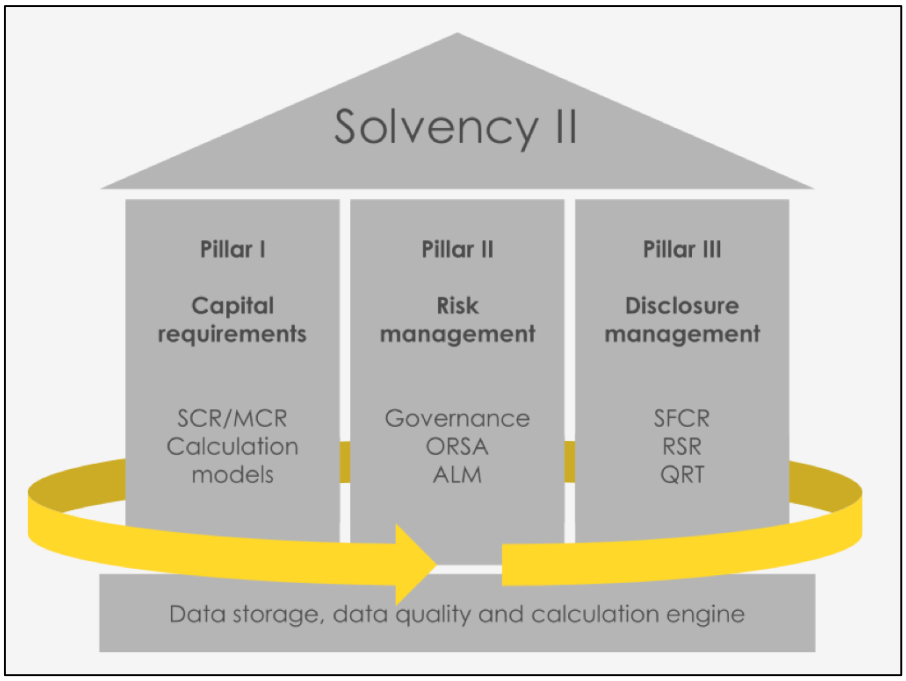
  The MCR is computed as a linear function. The function has many variables that consider technical provisions, written premiums, capital-at-risk, deferred tax and administration expenses. “The function shall be calibrated to the Value-at-Risk of the basic own funds of an insurance or reinsurance undertaking subject to a confidence level of 85% over a one-year period” (Solvency II association b [no date]).
  If a company funds go below the MCR and that the company is not able to raise them in a short period of time, the authority will retract the authorization of the company to carry on its activity.

- The second pillar deals with the governance and the supervision of the institutions. It promotes effective risk management systems. It also includes the

Own Risk Solvency Assessment (ORSA). The ORSA is a set of internal methods used to measure the solvency of a company. The ORSA considers in its solvency assessment the risk profile of the company. If a company is a risk taker, it will have to comply with higher solvency requirements. This pillar also determines the legal framework of the supervision of the organization (Lloyd's [no date]).

- The third pillar puts the framework about the transparency by defining what information must be published to the public and to the supervisors. The information shared are about risk management and capital adequacy (Lloyd's [no date]).

Figure 21 Solvency II

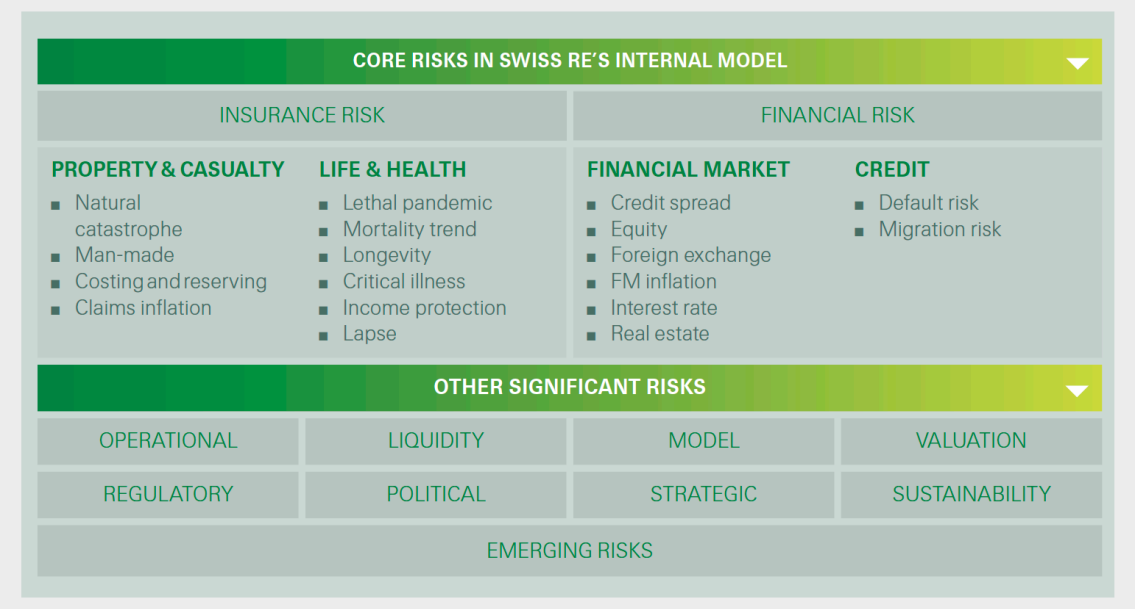


(Secondfloor2018)

It is interesting to see that insurance and reinsurance companies analyse deeply the impact of their longevity risk on their businesses and their capital requirements.

The figure below explains the risk management areas of the reinsurance companies Swiss Re. Swiss Re complies with the requirements of Solvency II and the Swiss Solvency Test.

Figure 22 Risk management areas for reinsurance companies



(Swissre 2018)

3.9 Insurance products / Bulk annuities used to transfer longevity risk

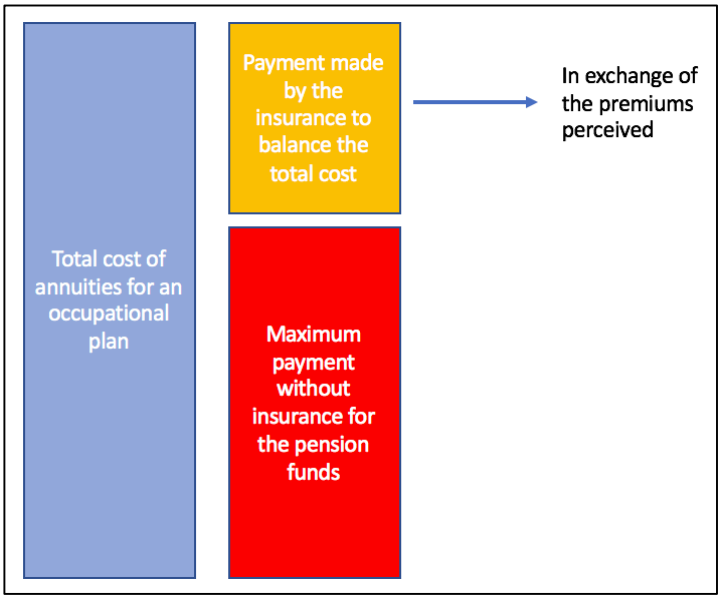
3.9.1 Buy-out

A buy-out is a transaction, which enables a pension fund to transfer an occupational pension plan and its related investments to an insurance company against a premium. This premium is determined thanks to a survival index. Under a buy-out, the insurer has different responsibilities. First, he must manage the whole portfolio of assets related to the occupational plan hedged. This means that the insurer bears the totality of the risks related to the portfolio. Second, the insurer is liable for the payments of annuities to the beneficiaries (Courbage 2014). The buy-out is the most expensive product to transfer longevity risk (Graziani 2012).

3.9.2 Buy-in

A buy-in is different than a buy-out. A pension fund pays premiums (based on survival index) to an insurance company in exchange of periodic payments related to an occupational plan. The pension fund is still the one who pays the annuities of the occupational plan. However, if the cost of the occupational plan reaches an agreed threshold (based on survival index) the insurance will make some payments to the pension fund. Under a buy-in, the pension fund still manages its portfolio and bears the risks related to its activity. The goal of a buy-in is to enable the pension fund to have a clear idea of its cash out and to minimize the longevity risk related to its occupational plan (Courbage 2014).

Figure 23 Visual policy of a buy-in



3.10 Financial derivative instruments

It exists many different financial derivative instruments to mitigate longevity risk but all of them have their payoff based on a survival index. They are essential for the buyer and the seller of the instrument to fix the price. The one who bears longevity risk is looking for transferring a part of his risk to an investor. The investors are interested in these financial derivative instruments because they allow them to differentiate widely their portfolios. Indeed, these instruments have a truly low correlation with more standard investments (Damen 2006). Having a low correlation between the instruments is fundamental for an investor, as it reduces the overall level of losses due to a particular event.

3.10.1 Swaps

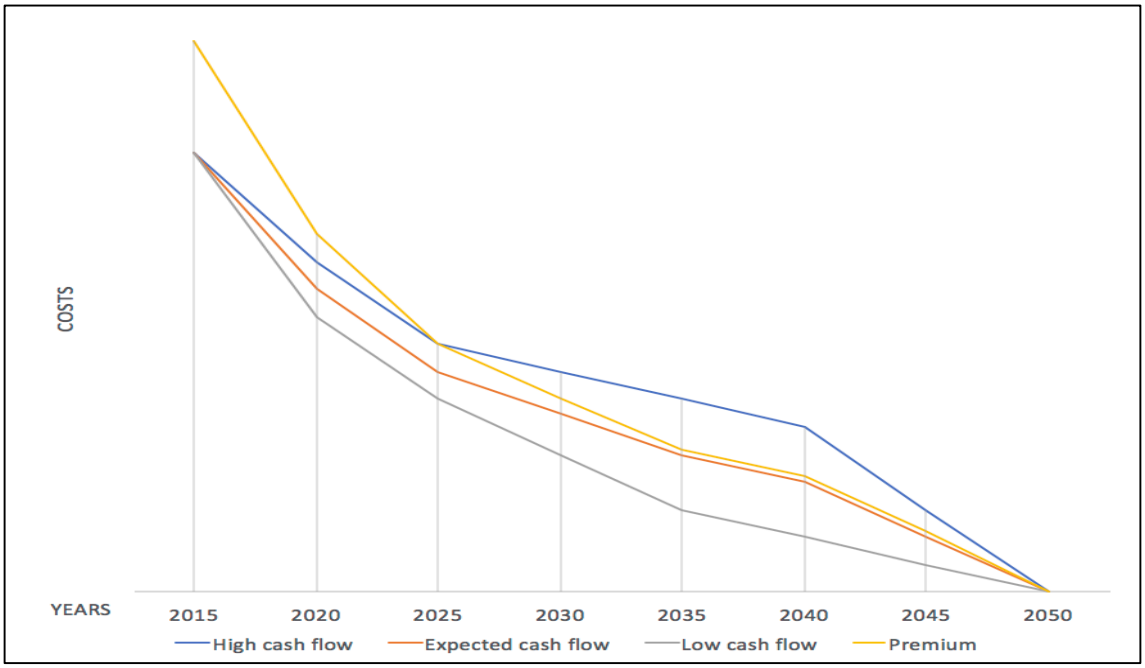
As mentioned earlier pension funds might not be able to guarantee their occupational pension plans and thus not provide annuities to retired people. A longevity swap could mitigate that longevity risk. The pension fund and the provider of the swap (counterparty) analyze together probable scenarios. These scenarios try to define accurately the life expectancy of a group of annuitants. Based on these scenarios both parties compute expected cash flows required to finance these annuities through time. The cash flows needed decrease as the population decreases. Once these estimated cash flows are known both parties start negotiating on a premium policy to transfer the longevity risk. A longevity swap works that way: The pension funds pays a monthly premium to the counterparty in exchange the counterparty pay the monthly rents.

At the beginning of swap's life, the premium is higher than the cash out paid by the counterparty. This is explainable by the truly high longevity risk that bears the counterparty. This situation might change depending on the real mortality rate of the annuitants.

The advantage for the pension fund is that it gains in visibility by knowing exactly its cash out (the premium) to finance its occupational pension fund. The pension fund is still responsible to invest in the rightful assets, that provide sufficiently return to pay its premium. This visibility in cash out enables the pension funds to have an efficient strategy about its future occupational plans. Nevertheless, doing a swap pension plan can be unprofitable for a pension fund. This unprofitable situation occurs when in the long run the premiums paid to the counterparty are higher than the actual cash-flows needed to pay the annuities. If a pension fund faces this situation, it will experience a decrease in its funding ratio (Forstell, Hudon, Monteiro 2015).

One essential element that a pension funds should keep in mind while transferring its longevity risk via a swap is that the swap might be sold to another counterparty. In the case of a sale the pension fund will have to deal with a new counterparty, this new counterparty might not be as solvent as the previous one. It might have some difficulties to face its commitment. Frequently, counterparty does not want to bear alone the entire longevity risk of an occupational plan. So, they enter into an agreement with another counterparty (most of the time reinsurance companies). The 1st counterparty pays a premium to the reinsurance company in exchange of the payment of a part of the annuities if the cash outs reach a threshold.

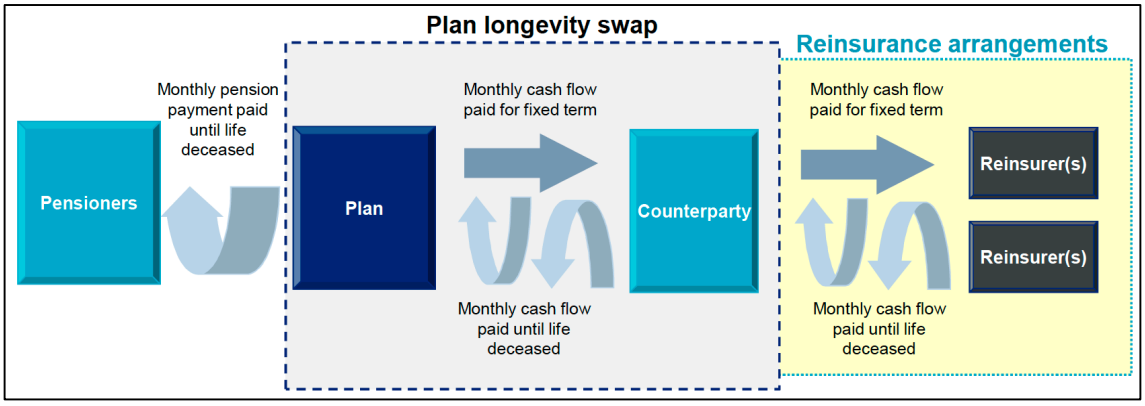
Figure 24 Visual longevity swap



(based on: Forstell, Hudon, Monteiro 2015)

Thanks to that figure we can visualize the cash flows required through the time. In 2015, the occupational plan is capital intensive as it has an important number of annuitants, whereas in 2050, it does not require any capital as all the annuitants have passed away. The impact of the longevity risk is the spread between the low cash flow (grey line) and the high cash flow (blue line). The counterparty loses money when he has to pay rents that are more important that premium (yellow line). The expected cash flow is the most probable cash flow required for the occupational pension plan according to the scenarios made by the counterparty. We can observe that the counterparty sells a premium slightly higher than the expected cash flow in order to make a profit.

Figure 25 Structure of a longevity swap

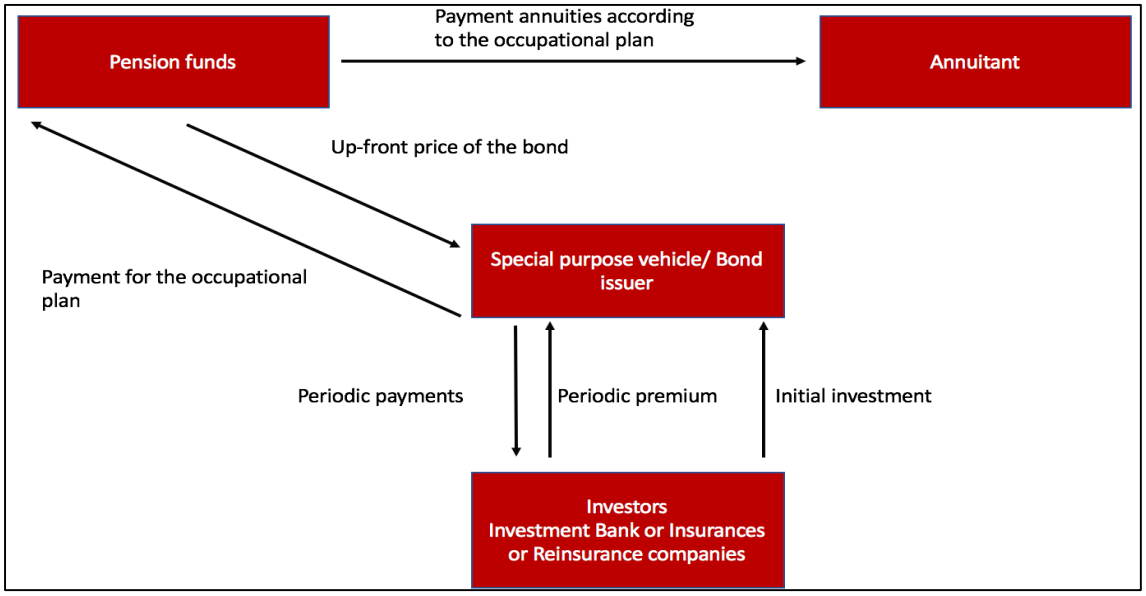


(Forstell, Hudon, Monteiro 2015)

3.10.2 Longevity bonds

Longevity bonds have some particularities. First, a longevity bonds does not pay back a principal but a terminal payment. This terminal payment is computed at the maturity of the bond and depends on the number of annuitants who have survived after the maturity of the bonds. Second particularity, the payment of the coupon evolves through the time and depends on the mortality rate of the annuitants. The payment of coupons will be for instance based on the proportion of the 65 years old people who are still alive at 75 years old (Blake, Boardman, Cairns 2013). It exists different kind of longevity bonds as they are tailor-made to the need of the buyer. Nevertheless, they all share the same initial structure.

Figure 26 Structure of a longevity bond



(Based on: Oppers 2012)

Once the terms of the longevity bonds are agreed by a pension fund and an investor, both parties create a special purpose vehicle. The goal of this identity is to issue the bond and to manage the difference in cash flows between the real cost of the occupational plan hedged and the estimations made thanks to the survival index. In order to hedge a part of its occupational plan, a pension fund must provide capital (up-front price of the bond) to the special purpose vehicle. The investors also provide an initial investment to the special vehicle.

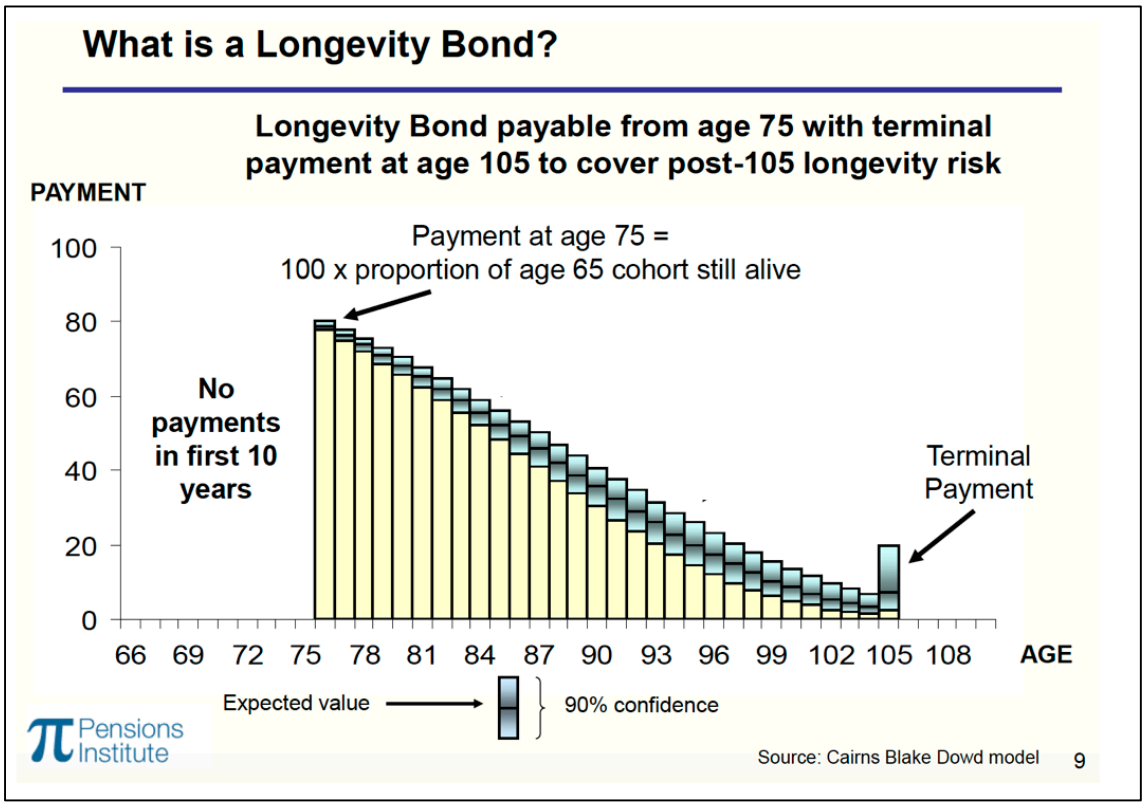
"The pricing of the bond is based on a cost of capital method. This method must:

- Determine the required credit rating
- Project the longevity risk capital required for each year to maintain the credit rating
- Multiply each annual capital requirement by a percentage cost of capital (based on the index) to give the cost of capital

Calculate the present value to give the present value of the overall capital requirement" (Blake, Boardman, Cairns 2013).

Once the bond is paid by the pension fund the longevity risk is transferred to the investors. Depending on the life expectancy and the mortality rate of the annuitants, the special vehicle will be able to provide coupons to the investors. However, if the index (on which, the bond was issued) underestimates the life expectancy of the beneficiaries, the investors will not receive any coupons. Longevity bonds do not guarantee a return on investment as their coupons are variable. The special vehicle purpose currently compares the actual mortality rate with the survival index and manage it.

Figure 27 Visual differed Longevity bond



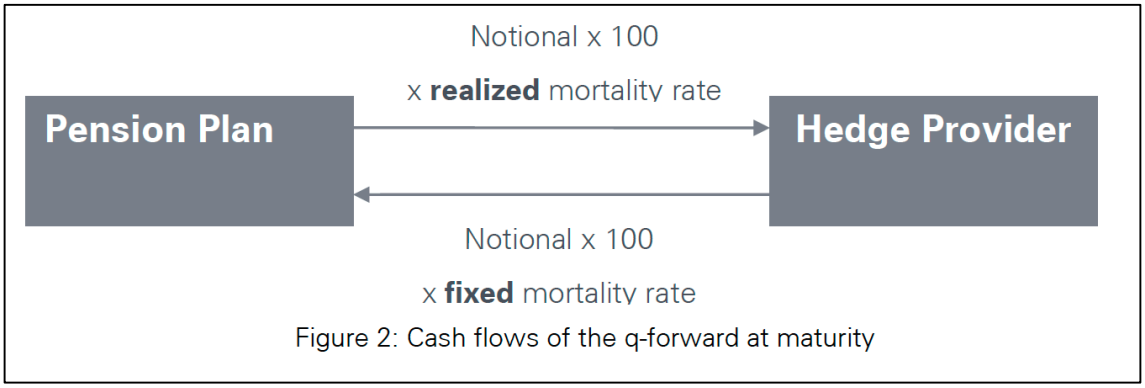
(Blake, Boardman, Cairns 2013)

The yellow columns of this graph represent the proportion of the beneficiary still alive of the occupational plan. The blue columns represent a range of possible payments (coupons) that will perceive the investors as return. In that case, the coupons are computed thanks to the expected value method with a 90% confidence interval. The sum of the blue and yellow columns represents the expected cash out for the special purpose vehicle. This example is interesting as we can see that during the construction of the bond both parties agreed not to provide any payments to investors for the ten first years of the bond. It is also important to understand that once the terminal payment is paid, the investors might still have to pay premium to the special purpose vehicle in order to pay the annuities of the beneficiary who are still alive. The computation of the terminal does take into account the required cash out for the investors. The most negative aspect with a longevity bond is the significant investment that parties must take up-front.

3.10.3 Q-forward contracts

"A q-forward *is an agreement between two parties to exchange at a future date (the maturity of the contract) an amount proportional to the realized mortality rate of a given population (floating leg), in return for an amount proportional to a fixed mortality rate (fixed leg) that has been mutually agreed at inception of the contract"* (Scheuenstuhl, Bloom, Brunner, Borger, Krayzler, Artinger 2012).

Figure 28 Structure of a q-forward contract



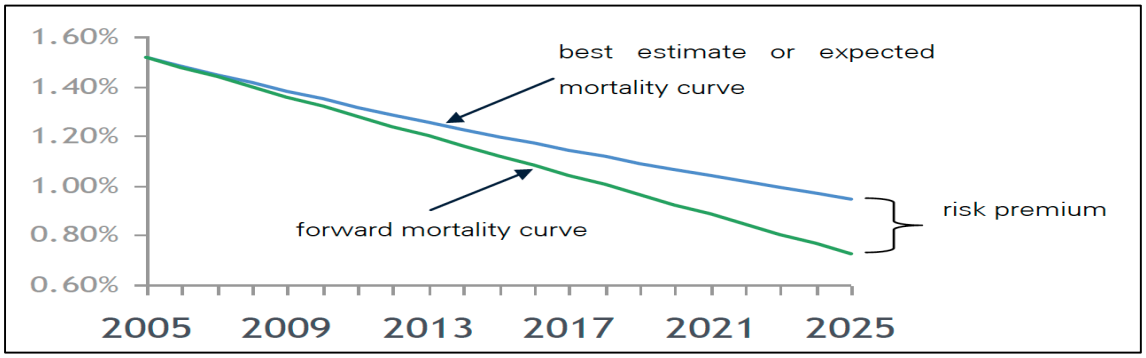
(Scheuenstuhl, Bloom, Brunner, Borger, Krayzler, Artinger 2012)

Q-forward contracts are capital market instruments that can be used to reduce hedge mortality and longevity risk. These contracts like the other financial derivative are based on indexes. A q-forward used by a pension funds to reduce its longevity risk works in the following manner. The pension fund enters into an agreement about a defined population of its occupational plan with an investor/counterparty. This counterparty is most of the time an investment bank. Even though the bank is frequently just a middleman between a pension fund and a life insurance company as mortality risk and longevity risk are opposite risk (Appendix 2 Interview Mr. Klein). This implies that pension funds and life insurance companies are natural counterparties. In a q-forward contract to reduce longevity risk, an investor agrees to pay a variable amount to a pension fund in the precise case where, the mortality rate (realized mortality rate) of a defined population is less important than a fix mortality rate. This fix rate is determined at the beginning of the contract. The computation of the fix rate is done thanks to actuarial techniques and statistic models. The fix mortality rate considers the risk premium of the investors and is consequently fix below the best estimate mortality rate, the pension fund on its side accepts to pay a variable amount to the investor in the case where the realized mortality rate is more important than the fix mortality rate. The difference between the fix-rate

perceived and the realized mortality rate represents the basis risk of the hedge (Coughlan, Epstein, Sinha, Honig 2007).

On one hand, q-forward contracts enable pension funds to perceive money from investors, when their commitments, (cash out) increase due to longevity risk. On the other hand, when their commitments decrease due to a higher mortality than expected the pension funds have sufficient capital to pay back the investors. By doing a q-forward contract, a pension fund knows exactly its cash out (for the duration of the contract) related to the commitment of its occupational plan. This maximum cash out is the fix mortality rate.

Figure 29 Fix mortality rate vs best estimate mortality rate



(Scheuenstuhl, Bloom, Brunner, Borger, Krayzler, Artinger 2012)

Figure 30 Example of a Q-forward contract

Fictive example of a Q-forward contract with a notional of 5'000'000 US dollars and a duration of five years and

Years	Realized Mortality Rate in %	Fixed Mortality Rate in %	Notional	Actual cash out	Cash out expected with the Fixed Mortality rate	Settlement
1	1.5	1.8	$5'000'000	$10'500'000	$9'000'000	$1'500'000
2	1.65	1.8	$5'000'000	$9'750'000	$9'000'000	$750'000
3	1.8	1.8	$5'000'000	$9'000'000	$9'000'000	$0
4	1.98	1.8	$5'000'000	$8'100'000	$9'000'000	-$900'000
5	2	1.8	$5'000'000	$8'000'000	$9'000'000	-$1'000'000
					Total settlement in favor of the pension fund	**$350'000**

It also exists the S-forward contract than works in a similar manner. The only difference is that a S-forward contract is done thanks to survival rates instead of mortality. In that case, the contract is done on the other sense. The fixed survival rate is computed for a pension fund and is compared with the realized survival rate. If the fixed survival rate is

less important than the realized survival rate, the pension fund will receive compensations from the investor and vis-versa (Scheuenstuhl, Bloom, Brunner, Borger, Krayzler, Artinger 2012).

3.11 Different markets for longevity risk

The Institute and Faculty of Actuaries has defined the main drivers of an attractive market from a provider of solutions point of view (Investment banks, insurance and reinsurance companies) and from a pension funds point of view.

The main drivers from a provider of solution point of view:

- Large pension market
- Existence of large pension funds
- Evident longevity risk and mortality improvement
- Drivers to de-risk longevity
- Market ready to de-risk pensioner at an acceptable price
- Adequate data available to produce suitable basis

The main drivers from a pension funds point of view:

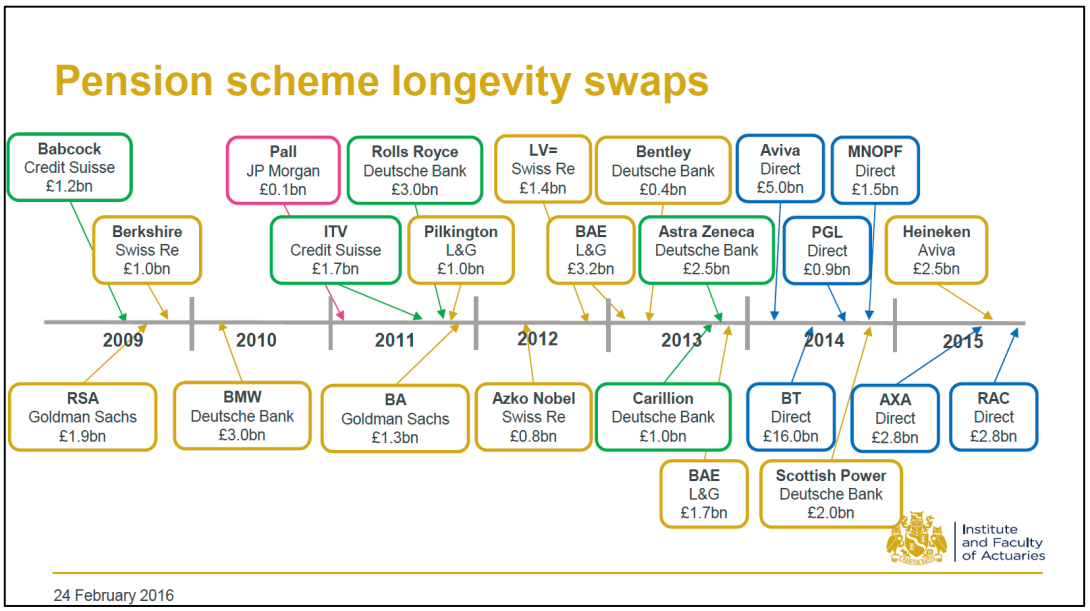
- Private companies manage occupational pension plans
- The level of funding of the pension funds
- Private companies bear the longevity risk
- The commitments/costs of occupational plans increase

Figure 31 Global markets

Characteristic	UK	Canada	Netherlands	US
Large pension market	✓✓✓	✓✓	?	✓✓✓
Existence of large DB pension funds	✓✓✓	✓	✓	✓✓✓
Evident longevity risk and mortality improvements	✓✓✓	✓✓	✓✓	✓✓
Drivers to de-risk longevity	✓✓✓	✓✓	✓✓	✓
Market ready to de-risk at an acceptable price	✓✓✓	?	?	✓
Adequate data available to produce suitable basis	✓✓✓	✓✓	✓✓	✓✓

(Pigott, Walker 2016)

Figure 32 The main longevity swaps worldwide between 2009 and 2015



(Wellard 2016)

3.11.1 United-Kingdom

The United-Kingdom is the leader worldwide in the transfer of longevity risk. This due to the fact the country is the only one that fulfill all the needs of the market.

In the United-Kingdom, it exists many solutions and products to transfer longevity risk. The pension funds transfer their risks trough bulk annuities and derivatives instruments. The first longevity swaps were sold in the UK in 2009. The market is truly advanced thanks to the development of survivor-indexes for its population. Most of the time the longevity swaps transactions are around 1 billion £. In the UK, investment banks, insurance and reinsurance companies propose financial derivative instruments. Another aspect that explains the faster development of the United-Kingdom in comparison with other countries is that the first transfers started a long time ago. Thus, investment banks insurance and reinsurance companies have now deeper knowledges of the occupational plans proposed within the country. The pension funds and the providers have also standardized their methods to measure longevity risk. For instance, they use the same periodic tables and projection models. In addition to that, insurance and reinsurance companies have understood the legislation of the United-Kingdom and have developed solutions in accordance to it (Pigott, Walker 2016).

3.11.2 United-States

The United-states is a promising market for the transfer of longevity risk for many reasons. The size of the market is enormous and pension funds are looking for solutions to transfer their longevity risk. Indeed, in 2016 the liabilities of pension funds associated with defined benefit occupational plan were estimated at around 2 trillion of US Dollars.

In addition to that, the providers of solutions (investment banks, insurance and reinsurance companies) have access to data of high quality regarding the US population. Before 2016 and the publication of a survival-index for the United-States by the Life and Longevity Market Association, the pension funds transferred only their longevity risk through insurance products. Thanks to this survivor-index, pension funds will have now wider possibilities to use financial derivative instruments. The significant presence of large pension funds in the US makes the market even more appealing for the potential providers of financial derivative instruments [Investment banks, insurance and reinsurance companies] (Pigott, Walker 2016).

3.11.3 Canada

The pension funds in Canada have mostly rely on buy-ins during the last decade to transfer longevity risk. The Canadian pension funds favor buy-ins rather than buy-outs as they are more affordable (Graziani 2012). In 2015, the country experienced its first longevity swap. This swap covers 5 billion (US Dollars) of liabilities (Pigott, Walker 2016). The Canada does not have its own survival-index yet. There is a significant challenge in the elaboration a survival-index for countries that have important populations like the United-States and the Canada. This is the trade-off in making a single index that represents the whole population or making several indexes for defined populations. On one hand, a single index enhances the liquidity of the market but does not measure accurately the mortality rates and the life expectancies of a defined population. On the other hand, a multitude of indexes makes the market illiquid but enhances the accuracy.

3.11.4 Australia

The market of Australia is less attractive than the one of the Unite-States or the Canada because the Australian private companies do not bear the risk of pension schemes. The financing of the retired people is mainly done through the purchase of buy term annuities. If a person outlives the annuities, it is then the Australian State that provides a rent to the survivor. So, it is the Australian State that bears the longevity risk (Pigott, Walker 2016).

3.11.5 Chile

Chile is the country, which has the highest life expectancy in South-America [79.52 years in 2016] (The world bank 2016). The country has been one of the pioneers in the transfer of longevity risk thanks to the high competition of life insurance firms. In 2011, 60% of retired people perceived annuities thanks to life insurance companies. The life insurance companies protect the retired people from longevity risk and inflation risk. In 2009 in Chile, a longevity bond was created to allow life insurance companies to transfer a part of their longevity risk to investors. The project of this longevity bond was possible thanks to the implication of the World Bank as sponsor. This longevity bond with a maturity of 25 years was a real experiment for the transfer of longevity risk. The structure of the bond was complex and included many actors. The bond was issued through a special purpose vehicle instrument. The structure was done by JP Morgan and the hedging was possible thanks to Munich Re. The reinsurer was an intermediary of the World Bank. Unfortunately, this longevity bond was not a success because Chilean life insurance companies did not invest sufficiently in the longevity bonds. This lack of interest was due to the following reasons:

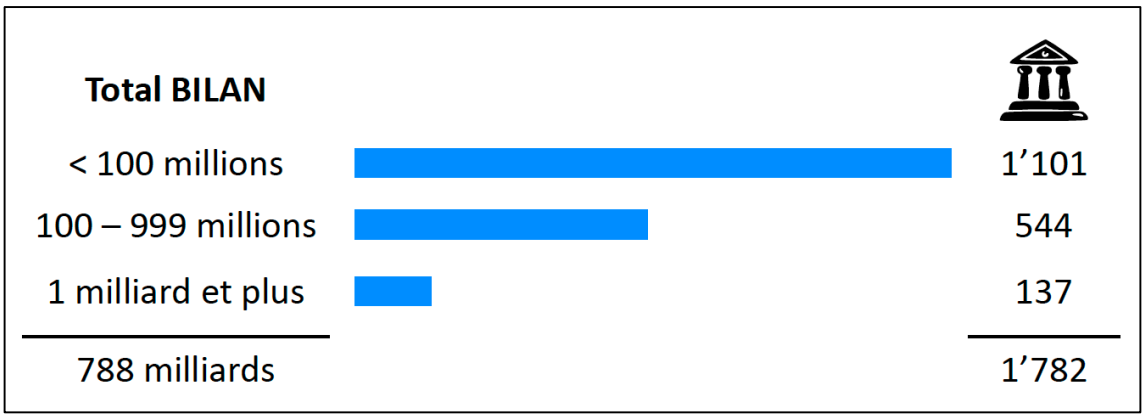
- The basic risk associate with the hedging solution
- The high cost of the insurance premium
- At that time longevity risk was perceived as not significant by the Chilean life insurance companies
- Chilean life insurance companies were more interested in tailor-made hedging solutions than a standardized one (Treasury the world bank 2011).

3.11.6 Switzerland

The Swiss market is potentially interesting for solutions providers as the life expectancy is constantly getting longer. The main issues linked to this market is that the biggest pension funds are not bound by law to transfer their longevity risk to third parties (Pigott, Walker 2016). Moreover, the market is relatively small for reinsurer companies and investment banks. These providers (investment banks, insurance and reinsurance companies) look for dealing principally with major pension funds but the Swiss market is mainly constituted of small pension funds. In 2015, Switzerland counted 137 pension funds that had more than 1 billion in their balance sheets. Furthermore, an important part of this large pension funds is public. This means that states will bail them out in case of problems. In Switzerland, the small pension funds with fewer than 300 beneficiaries or which have less than 100 million in their balance sheets must transfer their invalidity and

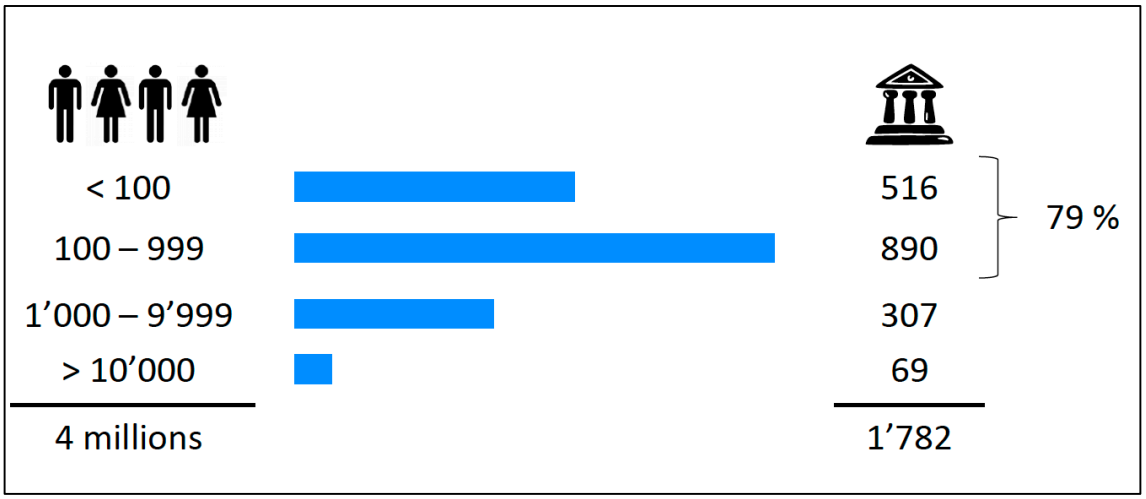
death risks to insurance companies (Appendix 3 Interview Mr. Hostettler). These risks are more important than the risk of longevity for pension funds. In Switzerland, the small pension funds do not use financial derivatives to transfer their risk. The insurance companies insure through buy-ins and buy-outs or other insurance products the small pension funds. However, these insurance companies transfer a part of their longevity risk to reinsurance companies through longevity swaps. Therefore, in Switzerland, the customers for long-term financial derivative instruments are more insurance companies than pension funds.

Figure 33 Repartition of the Swiss pension funds according to their balance sheet in 2015



(ASIP 2018 document received during the interview of Mr. Hostettler)

Figure 34 Repartition of the Swiss pension funds according to the number of beneficiaries in 2015



(ASIP 2018, Document received during the interview of Mr. Hostettler)

4. Discussion and main findings

The main finding of this paper is that the market for the transfer of longevity risk is limited in Switzerland due to the small number of large private pension funds. Indeed, the providers of solutions (investment banks, reinsurance and insurance companies) want to transfer significant quantity of longevity risk. For the providers of solutions, pension funds that own balance sheets representing less than 5 billion US Dollars are not interesting (Appendix 5 Interview Mr. Maeder). Moreover, the large public pension funds do not have the need to transfer their longevity risk as they have States that play the role of guarantors (Appendix 3 Interview Mr. Hostettler).

In addition to that, Swiss pension funds are not willing to use long-term financial derivative instruments to reduce their longevity risk. This is explainable by the specificity of the Swiss occupational pension system. The manner to share the longevity risk between actors is different. Indeed, in Switzerland, the system has been built in a way that private companies transfer their longevity risk to their pension funds. A private company and its pension fund are two distinct independent organizations. Thus, a private company is not fully liable for the activities of its pension fund. In other countries like the UK the situation is completely different and private companies bear the risk and the liabilities of pension funds. This implies that the incentive to the de-risking for Swiss private companies is much less important than in other countries facing similar challenges related to their aging-population. In the United-Kingdom, de-risking strategies are common. Indeed, in the UK private companies and State (as employer) want to transfer to third parties (individuals, banks, insurance and reinsurance companies) the risks linked to the activities of their pension funds (Appendixes 4 and 5 Interviews Mr. Romanens and Mr. Maeder). For example, the authorities and private companies encourage people to bear their longevity risk by withdrawing their second pillars. Swiss pension funds behave in the opposite way by mitigating their longevity risk instead of transferring the risk. They manage it. Swiss pension funds make important provisions to face this risk. These provisions are made thanks to actuarial tables that are updated every five years. The elaborations of these tables are possible thanks to the pooling of information from the Swiss pension funds. There are two main categories of tables, the LPP tables and the VZ tables. The LPP tables contain mainly data concerning people working in the private sector, whereas the VZ tables contain principally information about people working for the public sector. The employees working in the private sector have in average shorter life expectancies than the one working in the public sector (Appendix 3 Interview Mr. Hostettler). The system of actuarial tables used to analyze and manage longevity risk is not perfect. Indeed, all the pension funds have at their disposal the same

tables and information although they do provide annuities to truly different populations. For instance, UBS and Implenia two private companies do not face the same level of longevity risk. The pension fund of UBS experiences much longer life expectancy of its annuitants than the pension fund of Implenia (Appendix 4 Interview Mr. Romanens). Therefore, the pension funds have the responsibility to consider the biases of the tables and to adapt their projections according to their annuitants. Another problem linked to the use of these tables is that they are changed only every five years. This means that some annuities accorded to beneficiaries are based on relatively old projections. The risk is that the level of annuities is too important in comparison with the current level of longevity risk. Due to that, pension funds have to deal with shocks in longevity risk every five year during the switch of tables. The sector is currently shifting from periodic tables to generational tables to reduce that issue. The generational tables take into account the evolution of the longevity risk. Nevertheless, it is too early to analyze the real impact of this shift. Furthermore, there are some pressures to change the system of actuarial tables to measure and mitigate longevity risk. Some people would like to use an English multifactorial tool called Continuous Mortality Investigation (CMI). However, the different experts interviewed (Appendixes 4 and 5 Interviews Mr. Romanens and Mr. Maeder). are reluctant to the use of this instrument. They believe that there is no guarantee that the CMI will be more efficient than the actuarial tables. Moreover, they think that significant changes to the CMI have to be made to make it suitable to the Swiss market.

Although in Switzerland the occupational pension system obligates the pension funds to bear some risks, the system has fixed some limits. The small pension funds of fewer than 300 beneficiaries are judged to be risky. Consequently, they are bound by law to transfer their invalidity and their deaths risks to insurance companies (Appendix 3 Interview Mr. Hostettler). They transfer their risks via insurance products. It is interesting to see that this obligation does not include longevity risk. The Swiss authority and the different experts interviewed for the elaboration of this paper agree that it is not relevant to force pension funds to transfer their longevity risk. For them, the risk of longevity is more manageable than death and invalidity risks as it is predictable trough the time. This is not the case for the death and invalidity risks that can truly harm in unexpected ways small pension funds.

Another truly relevant point regarding the Swiss system is the existence of a guarantee fund. All the Swiss private pension funds contribute to this fund. In the case where a pension fund is in real distress and cannot be restructured and reorganized, the guarantee fund will rescue it and will guarantee its rents. The contribution of the pension funds to a common fund highlights a certain level of solidarity between these

organizations. This is also a technique to share the longevity risk with more players. The problem with the guarantee fund is its limited resources (Appendix 3 Interview Mr. Hostettler).

The complexity and the price of long term-financial derivative instruments linked to longevity risk are additional issues to their development in Switzerland. Indeed, the prices to hedge small longevity risk via these financial instruments are high. Investment banks, insurance and reinsurance companies charge truly high premiums to pension funds. This is explainable for several reasons. One reason is that the market of these financial instruments is in its early stage. At the moment, there is a low level of competition between the providers. Moreover, there is no economy of scale. The complexity to build these financial derivative instruments and the time required to their elaborations are additional reasons that impact the prices. Even if the market becomes more mature the prices of these instruments will stay significant. Finally, there is the cost for bearing the longevity risk. Mr. Klein also pointed out that it is difficult to find the right instrument that fits all the parties. He also expressed the high challenge for pension funds to define for which populations the use of derivative instruments is relevant (Appendix 2).

Regarding the providers of these instruments all the professionals agree that they do not want to deal with investment banks. Their main argument is that investment banks are just middlemen and are not longevity risk takers. Moreover, they do not sufficiently trust them concerning the elaboration of the derivative instruments. The experts believe that the investment banks will create instruments in their own interests rather than proposing profitable ones for both parties. Reinsurance companies are the best positioned to propose these financial instruments as they have higher knowledge in the elaborations of these financial instruments than insurance companies.

The measure of the supplementary benefit reform concerning the banishment of cashing out the mandatory part of the second pillar was refused by the National Council. The withdrawal of the capital implies the transfer of longevity risk from the pension fund to the beneficiary. According to the different experts, this measure would have had truly different impact on pension funds. For example, the measure would have had almost no impact on the longevity risk of the CPEG. This is explainable by the fact that almost all the beneficiaries of this pension fund do not withdraw their capital as the CPEG proposes generous occupational plans (Appendix 1 Interview Mr Béguet and Mr. Beun). The situation would have been completely different for certain small pension funds that already have some difficulties to guarantee the level minimum legal of rents. This is

particularly true for the restauration and the constructions sectors, where many beneficiaries decide to take their capital (Appendix 4 Interview Mr. Romanens). It is important to understand that once the first rent is accorded to a beneficiary, the pension fund cannot change its level. Therefore, it is truly important for pension funds to provide realistic occupational plan to face longevity risk.

5. Conclusion

This paper highlights the complexity of the Swiss occupational plan systems. Switzerland counts a significant number of pension funds 1'782 in 2015. One specificity of Switzerland is the significant proportion of small pension funds. Indeed in 2015, almost 80% of them counted less than 1'000 beneficiaries (1'406 pension funds). Moreover, 60% of the Swiss pension funds (1'101) have less than 100 million in their balance sheets (Table of figures 33 and 34). During the last decades, the country has been experiencing the progressive disappearance of its small pension funds. However, their number is still significant today. In addition to these different sizes, it exists other massive differences between these pension funds. Some of them are public and other are private. It also exists three big families of pension funds: the independent, the semi-independent and the collective. These various pension funds provide two types of occupational plans, the defined benefit plan and a combination of defined and contribution plan. All these particularities create truly specific needs for pension funds. This makes it difficult for the market to provide standardized solutions to transfer longevity risk. In Switzerland, the conditions to have an efficient capital market for the transfer of longevity risk via long-term financial derivatives instruments are not met. Indeed, the main providers (investment banks, insurance and reinsurance companies) look in transferring significant quantity of longevity risk. For them, a pension fund starts to be interesting when it has at least 5 billion of US dollars in its balance sheet (Appendix 5 Interview Mr. Maeder). In Switzerland, just a small number of pension funds reaches this size. Indeed, in 2015 the country counted only 137 pension funds (7.68%) that had more than 1 billion in their balance sheets (Appendix 3 Interview Mr. Hostettler). Moreover, some of these large actors are not interested in transferring their longevity risk as they are public entities. States can bail them out in case of insolvency.

The providers of these instruments (investment banks, insurance and reinsurance companies) are not in measure to propose affordable products to smaller pension funds that could be interested. Indeed, the premiums they charge to transfer longevity risk are enormous. Moreover, it would be truly challenging for small pension fund to determine

how to transfer their longevity risk with these instruments. They do not have the knowledge and the skills to use efficiently these instruments alone.

Another problem in Switzerland is linked to its small population. A small population makes it difficult to produce accurate statistical measures to produce relevant survivor index (Appendix 4 Interview Mr. Romanens). Survivor indexes that are fundamental to the elaboration of long-term financial derivative instruments.

Finally, as mentioned in the discussion, there is a major difference between Switzerland and the United-Kingdom the most developed market for the transfer of longevity risk. In Switzerland, a private company and its pension funds are two distinct entities, whereas in the UK it is a single entity. This means that in the UK private companies bear much more longevity risk than in Switzerland, where private companies have already transferred a part of their longevity risk to their pension funds. In the United-Kingdom, private companies have significant incentives to transfer their longevity risk to other participants such as individuals, investment banks, insurance or reinsurance companies. In the United-kingdom, a person that is under a defined contribution plan does not have a minimum level of rent guarantee like in Switzerland. At the time of retirement, this person might have to purchase annuities thanks to his capital to an insurance company. The pension funds in Switzerland have a function to bear longevity risk. They minimize the risk of longevity by doing provisions based on actuarial tables (LPP and VZ). The different experts interviewed believe that the Swiss system allows the management of longevity risk.

Based on the above observations, this research has concluded that most of the Swiss pension funds should not use long-term financial derivative instruments to reduce their longevity risk. Pension funds should focus on their various investments and their occupational plans. The large private pension funds with more than 5 billion in their balance sheets and facing a high longevity risk are the only ones that should transfer a part of their longevity risk via these financial instruments. However, these large private structures are a tiny proportion of the Swiss pension funds. An assumption made is that there are less than 20 in Switzerland. It would be truly interesting to find the correct number. Therefore, it is unlikely that the providers of these financial instruments will invest to develop the Swiss market. The small number of potential customers makes the market unprofitable and uninteresting. Nevertheless, in the long run, this situation could change as the number of small pension funds is currently decreasing. This leads to the appearance of more important structures. The probability that the Swiss market becomes

interesting in a close future for the providers is truly low. Indeed, there is no guarantee that in the long run the number of large private fund will increase drastically.

Concerning the providers of financial instruments this paper reached the conclusion that reinsurance companies are the best positioned to propose long-term financial derivative instruments due to their business models and their capacity to build derivative instruments.

It would be interesting for future studies to look at the system of actuarial tables and determine if it underestimates longevity risk. It would be relevant to understand how pension funds take into account the biases of the tables for their defined populations. The creation of more specific tables dedicated to defined populations could help pension funds to propose relevant occupational plans and manage more efficiently longevity risk. Although, this idea might be difficult to implement due to the small size of the Swiss population.

Bibliography

1. AGENCE TELEGRAPHIQUE SUISSE SA, 2017. Le 2e pilier devrait rester une rente, sauf pour les indépendants. *Parlament.ch* [online]. 31 May 2017. [Viewed 19 April 2018]. Available from: https://www.parlament.ch/fr/services/news/Pages/2017/20170531131831903194158159041_bsf097.aspx

2. ASIP 2018. Formation conseils de fondations. *Asip.ch* [online] 26 April 2018 [Viewed 2 May 2018]. Available from: http://www.asip.ch/savoir/conferences/?locale=fr_CH (Received during interview in pdf by Mr. Hosttetler).

3. AXA WINTERTHUR, 2016. All you need to know about Pillar 2, *Axa.ch* [online]. [Viewed 20 January 2018]. available from: https://www.axa.ch/doc/aa5rs

4. BARRIEU Pauline, BENSUSAN Harry, El KAROUI Nicole, HILLAIRET Caroline, LOISEL Stéphane, RAVANELLI Claudia and SALHI Yahia, 2010 Understanding, Modelling and Managing Longevity Risk: Key Issues and Main Challenges. *Archives-ouvertes.fr* [online]. 16 July 2010[Viewed 10 April 2018]. Available from: https://hal.archives-ouvertes.fr/hal-00417800v2/document

5. BASEL3 COMMITTEE ON BANKING SUPERVISION, 2014. The net stable funding ratio. *Bis.org* [online]. The Bank for International settlements. October 2014. Page 2. [Viewed 21 February2018]. Available from: https://www.bis.org/bcbs/publ/d295.pdf. ISBN 978-92-9131-960-2

6. BLAKE David, BOARDMAN Tom, CAIRNS Andrew, 2013. Sharing longevity risk why governments should issue longevity bonds. Actuaries.org [online] 18 February 2013. [Viewed 14th March 2018]. Available from: https://www.actuaries.org.uk/documents/longevity-bonds

7. BLAKE, David, MORALES Marco, 2017. Longevity risk and capital markets: the 2014–15 update. Journal of Risk and Insurance [online]. 10 April 2017. Vol. 84, issue S1, pp. 279–297. [Viewed 17 October 2017]. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/jori.12213

8. CENTRE D'INFORMATION AVS/AI, OFFICE FEDERAL DES ASSURANCES ET SECRETARIAT A L'ECONOMIE, 2017. La sécurité sociale en Suisse

l'assujettissement au régime suisse de sécurité sociale. [Viewed 20th February 2018]. Available from: https://www.ahv-iv.ch/p/890.f

9. COUGHLAN, EPSTEIN, SINHA and HONIG, 2007. Q-forwards: Derivatives for transferring longevity and mortality risk. *Researchgate.net* [online]. 2 July 2007. [Viewed 8 May October 2018]. Available from: https://www.researchgate.net/publication/256109844_q-Forwards_Derivatives_for_Transferring_Longevity_and_Mortality_Risks

10. COURBAGE, Christophe, 2014. Le transfert du risque de longévité est en plein essor. *Le Temps* [online]. 27 April 2014. [Viewed 19 March 2018]. Available from: https://www.letemps.ch/economie/transfert-risque-longevite-plein-essor

11. CSSS-N COMMISSIONS DE LA SECURITE SOCIALE ET DE LA SANTE PUBLIQUE, 2018. La réforme des PC prête pour le Conseil National. *Parlament.ch* [online]. 23 February 2018. [Viewed 19 April 2018]. Available from: https://www.parlament.ch/press-releases/Pages/mm-sgk-n-2018-02-23.aspx?lang=1036

12. DAMEN, Wilbur 2006. The use of mortality bonds to hedge the longevity risk of pension funds, *Arno.uvt* [online]. September 2006, [Viewed 13 March 2018]. Available from: http://arno.uvt.nl/show.cgi?fid=59281

13. DURAND Olivier, GAILLE Séverine, 2013. Switzerland: Current Retirement System and Future Prospects, Life and Pensions Newsletter (the four pillars), Life and pension N°52, The Geneva Association Risk & Insurance Economics. *Genevaassociation.org* [online] March 2013. [Viewed 13 March 2018]. Available from: https://www.genevaassociation.org/research-topics/global-ageing/future-retirement-systems

14. FORSTELL Paul, HUDON Benoit, MONTEIRO Manuel, 2015. Pension Longevity risk, Mercer lead advisor on first ever Canadian pension longevity insurance transaction. *Mercer.ca* [online]. March 2015, [Viewed 6th March 2018]. Available from: https://www.mercer.ca/content/dam/mercer/attachments/north-america/canada/ca-2015-longevity-webcast-march-10-en.pdf

15. GARESSUS, Emmanuel, 2016. Les experts prévoient une forte baisse du nombre de caisses de pension. *Le Temps* [online]. 17 November 2016. [Viewed 19 March 2018]. Available from:

https://www.letemps.ch/economie/experts-prevoient-une-forte-baisse-nombre-caisses-pension

16. GAVIN, Jones, 2013. longevity risk and reinsurance. *Reinsurance News* [online]. July 2013. Issue 76, pp. 11-14. [Viewed 17 October 2017]. Available from: https://www.soa.org/library/newsletters/reinsurance-section-news/2013/july/rsn-2013-issue76-jones.aspx

17. GRAZIANI, George, 2012. Managing longevity risk. *Benefitscanada.com* [online]. 11 January 2012. [Viewed 6 May 2018]. Available from: http://www.benefitscanada.com/pensions/db/managing-longevity-risk-2-24304

18. HARI Norbert, DE WAEGENAERE Anja, MELENBERG Bertrand and NIJMAN Theo, 2007. Longevity risk in portfolios of pension annuities. *Sciencedirect.com* [online]. January 2007. [Viewed: 6th April 2018]. available from: http://arno.uvt.nl/show.cgi?fid=88313&origin=publication_detail

19. JEANNERAT, Ignace, 2015. Qui sont les plus grandes caisses de pension en Suisse? *Le Temps* [online]. 26 April 2015. [Viewed 19 March 2018]. Available from: https://www.letemps.ch/economie/plus-grandes-caisses-pension-suisse

20. JORIO, Luigi, 2017. The three Swiss pension pillars, explained. *Swissinfo* [online]. 1 March 2017. [Viewed 19 April 2018]. Available from: https://www.swissinfo.ch/eng/business/pillars-of-society_the-three-swiss-pension-pillars-explained/42995426

21. LEE, Ronald, 2000. The Lee-Carter method for forecasting mortality with various extension and application, *researchgate.ch* [online]. January 2000. [Viewed 24 April 2018]. Available from: https://www.researchgate.net/publication/228560399

22. LES AUTORITES SUISSES EN LIGNE, [no date]. Retirer son avoir de caisse de pension avant la retraite *Ch.ch* [online]. [Viewed 13 March 2018]. Available from: https://www.ch.ch/fr/retirer-caisse-pension/

23. LIFE AND LONGEVITY MARKET ASSOCIATION, 2012. Longevity Index Technical Document (version1.0). *llma.org* [online]. 19 March 2012. [Viewed 15 April 2018]. Available from: https://llmablog.files.wordpress.com/2017/08/llma_longevity_index_technical_document_19-3-12_v1_final.pdf

24. LLOYD'S, [no date], What is solvency II?. *Lloyds.com* [online]. [no date]. [Viewed 30 Mai 2017]. Available from: https://www.lloyds.com/market-resources/regulatory/solvency-ii/about/what-is-solvency-ii

25. MARIANI, Daniele and NGUYEN, Duc-Quang, 2016. Les défis de la retraite dans une Suisse qui vieillit. *Swissinfo* [online]. 4 July 2016. [Viewed 17 October 2017]. Available from: https://www.swissinfo.ch/fre/societe/pr%C3%A9voyance-vieillesse_les-d%C3%A9fis-de-la-retraite-dans-une-suisse-qui-vieillit/42247592

26. MCMULLAN Kerry, WOLONGIEWICZ Daniel and SINGLETON Matt, 2012. A mature market, Building a capital market for longevity risk. *Swissre.com* [online]. 24 September 2012. [Viewed 18 October 2017]. Available from: http://media.swissre.com/documents/Mature_Market_EN.pdf

27. OFFICE FEDERAL DE LA STATISTIQUE, 2017a. Statistique des caisses de pensions. *bfs.admin.ch* [online]. 18. December.2017. [Viewed 5th January 2017]. Available from: https://www.bfs.admin.ch/bfs/fr/home/statistiques/securite-sociale/prevoyance-professionnelle/institutions-assures-actifs.html

28. OFFICE FEDERAL DE LA STATISTIQUE, 2017b. Statistique des caisses de pensions. *bfs.admin.ch* [online]. 18. December.2017. [Viewed 5th January 2017]. Available from: https://www.bfs.admin.ch/bfs/fr/home/statistiques/securite-sociale/prevoyance-professionnelle/bilan-compte-exploitation.assetdetail.4142251.html

29. OFFICE FEDERAL DE LA STATISTIQUE, 2017c. Statistique des caisses de pensions. *bfs.admin.ch* [online]. 18. December.2017. [Viewed 5th January 2017]. Available from: https://www.bfs.admin.ch/bfs/fr/home/statistiques/securite-sociale/prevoyance-professionnelle/bilan-compte-exploitation.assetdetail.4142252.html

30. OFFICE FEDERAL DE LA STATISTIQUE, 2018. Population Panorama. *bfs.admin.ch* [online]. March 2018. [Viewed 6th April 2018]. Available from: https://www.bfs.admin.ch/bfs/fr/home/statistiques/population.assetdetail.4522223.html

31. OFFICE FEDERAL DE LA STATISTIQUE,2015. Les scénarios de l'évolution de la population de la Suisse 2015-2045, *bfs.admin.ch* [online]. Published in 2015. [Viewed 18th April 2018]. Available from:

https://www.bfs.admin.ch/bfs/fr/home/statistiques/catalogues-banques-donnees/publications.assetdetail.350327.html

32. OFFICE FEDERAL DES ASSURANCES SOCIALES, 2016. Prévoyance professionnelle : le taux d'intérêt minimal est abaissé à 1%. *Admin.ch* [online]. October 2016. [Viewed 15 March 2018]. Available from: https://www.admin.ch/gov/fr/accueil/documentation/communiques.msg-id-64228.html

33. OFFICE FEDERAL DES ASSURANCES SOCIALES, Le deuxième pilier de la prévoyance vieillesse, survivant et invalidité après la 1re révison de la LPP, La prévoyance professionnelle,bsv.admin.ch January 2017. [Viewed12 March 2018]. Available from https://www.bsv.admin.ch/.../la_prevoyance_professionnelleapresla1rerevision.pdf

34. OFFICE FEDERALE DES ASSURANCES SOCIALES, 2018. PC : aperçu des principales mesures. *Bsv.admin.ch* [online]. 19 February 2018. [Viewed 13 March 2018]. Available from: https://www.bsv.admin.ch/bsv/fr/home/assurances-sociales/el/reformen-und-revisionen/el-reform.html

35. OPPERS ERIC, 2012. Financial impact of longevity. *Financepractioner.com*[online]. 2012. [Viewed 14 March 2018]. Available from: http://www.financepractitioner.com/financial-risk-management-best-practice/financial-impact-of-longevity-risk?page=3

36. Ordonnance sur la prévoyance professionnelle vieillesse, survivants et invalidité (OPP 2 ; RS 831.441.1). Les autorités fédérales de la confédération suisse [online]. 18 April 1984. Updated 1 October 2017. [Viewed 28 February 2018]. Available from: https://www.admin.ch/opc/fr/classified-compilation/19840067/201604010000/831.441.1.pdf

37. PIGOTT Christopher, WALKER Michael, INSTITUTE AND FACULTY OF ACTUARIES, 2016. Longevity swap markets – why just the UK?. *Actuaries.org* [online]. 4 November 2016. [Viewed 6 May 2018]. Available from: https://www.actuaries.org.uk/documents/e8-longevity-swap-markets-why-just-uk

38. PROFOND, [no date]. Institution de prévoyance. *Profond.ch* [online]. [Viewed 21 of February 2018]. Available from:

http://profond.ch.smaragd.metanet.ch/fr/vorsorgethemen/glossar/pension-schemes_14284.html

39. RETRAITES POPULAIRES, 2018. Quel taux de conversion et comment s'applique la méthode du splitting? *Retraitespopulaires.ch* [online]. [Viewed 19 March 2018]. Available from: https://www.retraitespopulaires.ch/questions-reponses/prevoyance-professionnelle/taux-de-conversion-methode-splitting

40. SCHEUENSTUHL, BLOOM, BRUNNER, BORGER, KRAYZLER and ARTINGER, 2012. Financial study: longevity risk within pension systems. Ifa-ulm.de [online]. Janary 2012. [Viewed 8 May October 2018]. Available from: https://www.ifa-ulm.de/fileadmin/user_upload/download/forschung/2012_ifa_Scheuenstuhl-etal_Longevity-Risk-within-Pension-Systems.pdf

41. SECONDFLOOR, 2018. Entreprise reporting for solvency 2. *Secondfloor.com* [online]. 2018. [viewed 27 April 2018]. Available from: https://www.secondfloor.com/solvency-ii-enterprise/

42. SINGLETON Matt, THOMSEN Torben, YIASOUMI Costas, 2010. A shorter guide to longer lives, Longevity funding issues and potential solutions. *Swissre.com* [online]. 2010. [Viewed 6 May 2018]. Available from: http://media.swissre.com/documents/Longer_lives.pdf

43. SOCIETY OF ACTUARIES, 2016. Advance reinsurance seminar. *Soa.org* [online]. 15th August 2016. [Viewed 6th April 2018]. Available from: https://www.soa.org/Files/Pd/2016/advanced-reinsurance-seminar/pd-2016-08-advanced-reinsurance-longevity-risk.pdf

44. SOLVENCY II ASSOCIATION a [no date]. The solvency capital requirement, *Solvency-ii-association.com* [online]. [no date]. [Viewed 1 May 2018]. Available from: http://www.solvency-capital-requirement.com

45. SOLVENCY II ASSOCIATION b, [no date]. The minimum capital requirement (MCR), *Solvency-ii-association.com* [online]. [no date]. [Viewed 1 May 2018]. Available from: http://www.minimum-capital-requirement.com

46. SWISSRE, 2018. Business report: Resilience in action. *Swissre.com* [online]. 2018. [Viewed 27 April 2017]. Available from: http://reports.swissre.com/2017/

47. TAMM Külli and KIROVA Milka, 2011. Longevity risk and protection for Canada. *Swissre.com* [online]. 24 October 2011. [Viewed 20 October 2017]. Available from: http://institute.swissre.com/research/overview/expertise_publication/Longevity_risk_and_protection_for_Canada.html

48. THE WORLD BANK, 2016. Life expectancy at birth total (year). *Data.worldbank.org* 2016. [Viewed 7 May 2018]. Available from: https://data.worldbank.org/indicator/SP.DYN.LE00.IN

49. TREASURY THE WORLD BANK, 2011. Longevity 7 conference: Longevity risk hedging and the stability of retirements system: The chilean longevity bond case. *Longevit-risk.org* [online]. 8 September 2011. [Viewed 7 May 2018]. Available from: http://www.longevity-risk.org/Pres_Zelenko.pdf

50. WELLARD Richard, INSTITUTE AND FACULTY OF ACTUARIES, 2016. Developments in longevity risk transfer. *Actuaries.org* [online]. 24 February 2016. [Viewed 6 May 2018]. Available from: https://www.actuaries.org.uk/documents/developments-longevity-risk-transfer

51. WELSCH Fabrice, 2011. Taux technique et taux de conversion, *Swisstreasurer.ch*, 2011, [online]. November 2011, [Viewed 4th April 2018]. Available from: https://www.swisstreasurer.ch/wp-content/uploads/2014/11/WEF-Taux-technique-et-de-conversion.pdf

52. ZIMMERMANN, Sarah, 2017. What are the potential impacts of banishing the choice of cashing out the second pillar at the age of retirement in Switzerland? *Doc.rero.ch* [online]. Geneva Haute école de Gestion of Geneva. Travail de Bachelor. [Viewed 13 March 2018]. Available from: http://doc.rero.ch/record/306000?ln=fr

Appendix 1 Interview de Monsieur Béguet et Monsieur Beun

Monsieur Béguet Directeur Général des Finances du Canton de Genève et ancien Président de la Caisse de prévoyance de l'Etat de Genève (CPEG)
Monsieur Beun, Chef de service de l'Etat de Genève.

Date 09.04.2018

1. *Comment minimisez-vous votre risque de longévité ?*

A la CPEG, le risque de longévité est minimisé grâce à du provisionnement. Ce provisionnement est fait à l'aide de tables périodiques réalisées par des experts actuaires. La table périodique de 2015 est toujours utilisée à ce jour. Elle requiert un provisionnement annuel à hauteur de 0.5% de la valeur totale des engagements envers les assurés de la caisse. Le bilan de la CPEG se monte à CHF 21 milliards. Néanmoins, un réajustement de la table va avoir lieu prochainement. Ce taux de 0.5% va être abaissé à 0.3% car à l'heure actuelle le taux technique est à la baisse.

La CPEG ne transfert pas son risque de longévité à des entreprises de réassurance, vu les conditions des primautés des prestations proposées par la caisse. Les buy-ins ou buy-outs ne sont intéressants pour aucune des parties.

2. *Changez-vous vos régimes de prestations pour des régimes de contributions ?*

La CPEG propose uniquement des régimes de primauté des prestations. En 2018, la Commission des finances du Grand Conseil genevois a voté à une courte majorité le projet de loi pour recapitaliser la CPEG tout en maintenant la primauté des prestations. Ce projet de loi sera soumis au vote lors de la prochaine séance du Grand Conseil de ce mois d'avril. S'il est accepté par le Parlement, il est fort probable qu'un référendum soit lancé et aboutisse. Dès lors, il appartiendra au peuple de trancher. En 2015, grâce à du provisionnement, L'Etat genevois a versé CHF 400 millions à La CPEG. Cette réserve permet à la CPEG d'être dans une situation plus confortable. En tant que garant, l'Etat genevois a dû recapitaliser la caisse à cause d'une obligation fédérale qui pénalise les caisses sous-capitalisées pendant une trop longue période. Le problème du système de régime de primauté des prestations est qu'il ne permet aucune flexibilité aux caisses.

Cela signifie que le niveau de certaines rentes peut être complétement déconnecté de la conjoncture économique et des retours des marchés financiers. Par conséquent, l'unique levier à disposition de la CPEG pour minimiser son risque de longévité est la diminution des prestations des actifs actuels.

3. *Quels outils utilisez-vous pour estimer l'espérance de vie des futurs retraités ?*

Des experts actuaires sont responsables d'estimer l'espérance de vie. Ils basent leurs analyses grâce à des tables périodiques (les mêmes utilisées pour le provisionnement)

4. *Dans le cas d'une faillite d'un fonds de pension, qui le sauve :*
    a. *L'Etat ?*
    b. *Solidarité entre les fonds de pension ?*
    c. *L'entreprise associée au fonds de pension ?*

La CPEG est une caisse de pension particulière car elle est étatique. Par conséquent, elle a certaines particularités. Par exemple, son taux de couverture est inférieur de 100% (61.2%), ce qui est possible uniquement parce que l'Etat genevois est garant.

La CPEG ne rentrera jamais à proprement parler en faillite grâce à ses nombreux placements qui génèreront toujours des profits. Néanmoins, dans le cas où la caisse de pension ne pourrait plus faire face à ses obligations (paiements de ses régimes de retraite professionnelle) et se trouverait alors dans une situation intenable, L'Autorité de Surveillance des Fondations et Institution de Prévoyance (ASFIP), autorité indépendante de l'Etat de Genève, prendrait la décision de stopper le fonctionnement de la caisse. L'Etat, comme garant, financerait les régimes de retraite dus par la CPEG. L'ASFIP transfèrerait les actifs de la caisse à une caisse supplétive. Cette caisse supplétive aurait la responsabilité de gérer les régimes de retraite professionnelle des personnes actives. Le problème, pour les actifs, est que cette caisse de compensation supplétive ne garantit que le minimum légal de la LPP, soit des prestations bien moins intéressantes que la CPEG. Ce cas est extrême. Néanmoins avant d'atteindre cette situation, L'Etat peut recapitaliser lui-même la CPEG avant d'envisager le passage à la caisse supplétive mais une telle opération nécessite le vote d'une loi et l'adhésion du peuple genevois.

5. *Au sens plus large, quel est le risque de longévité pour les individus, les fonds de pension, les entreprises privées et l'Etat ?*

De manière générale, le risque de longévité est toujours supporté par les employeurs et les personnes actives. L'employeur, dans la mesure où il est obligé d'augmenter sa part de cotisation pour conserver une caisse pérenne et de respecter la loi qui impose un minimum de taux de couverture. L'actif, dans la mesure où il voit son niveau de rentes diminué. Il est essentiel de comprendre que la CPEG maîtrise et à sous contrôle son risque de longévité grâce à ses provisions. Le risque a un impact uniquement lorsqu'il se matérialise.

6. *Pensez-vous que la réforme des prestations complémentaires PC pourra motiver certains fonds de pension à transférer une partie de leur risque de longévité via des instruments financiers dérivés (Swap Longevity bonds) ?*

La réforme des prestations complémentaires PC n'a qu'un impact infime sur le risque de longévité de la CPEG. Une part infime des bénéficiaires retirent une partie de leur capital lors de leur départ à la retraite. Cette réalité est explicable par les prestations généreuses proposées par la caisse. De plus, ce genre de « petites » réformes n'ont pas un impact significatif pour les caisses de pension. Le réel problème est que nous avons changé d'époque : les trente glorieuses sont passées, le niveau des prestations est trop élevé par rapport au retour des investissements sur les marchés financiers. La croissance mondiale est en recul ces dernières années.

7. *Utilisez-vous des instruments financiers types Swap ou obligation de longévité pour transférer une partie de vos risques (considérez-vous les buy-ins et buy-outs) ?*

Non, nous n'utilisons pas ce genre d'instruments. Pour plusieurs raisons, la CPEG est la dixième plus grande caisse de pension de Suisse. Cela signifie qu'elle a à sa disposition des cerveaux et les compétences nécessaires pour gérer elle-même son risque de longévité. Les fournisseurs de ces instruments ne sont pas en mesure de nous proposer des produits intéressants. Ces instruments peuvent être utiles pour les petites caisses qui délèguent la gestion de leurs actifs à des professionnels de la finance. La prévoyance professionnelle est un domaine complexe et les petites structures ne possèdent pas suffisamment de ressource pour gérer l'ensemble de leurs activités. Comme mentionné précédemment, nous n'utilisons pas de buy-in et de buy-out car les

produits présents sur le marché ne sont pas intéressants. Néanmoins, la CPEG est un investisseur d'obligation catastrophes naturelles.

8. *Pourquoi les fonds de pension suisses n'utilisent-ils pas d'instruments financiers dérivés alors que de nombreux pays qui ont la même problématique le font ?*

Un point fondamental concernant ces instruments financiers : ils sont constamment créés en faveur de la banque, de l'assurance ou de la réassurance qui les émet (clauses dans le contrat). Par mesure de précaution, un instrument financier ne devrait être utilisé que si le bénéficiaire comprend complètement comment il fonctionne et qu'il puisse faire lui-même ses simulations. Les instruments proposés actuellement sont beaucoup trop complexes et personne ne les maîtrise totalement. De plus, ces instruments sont trop incertains. Ils sont créés à un moment précis en fonction d'une certaine conjoncture économique qui peut évoluer au cours du temps. Par exemple, personne n'avait anticipé les taux d'intérêts négatifs, or ces taux négatifs ont eu un impact important pour les utilisateurs de ces instruments.

9. *Selon vous, y a-t-il des effets pervers liés à l'utilisation de ces instruments ?*

Ces instruments sont utiles quand ils sont utilisés dans un cadre raisonnable. Sinon ils peuvent mener à de graves conséquences.

10. *Selon-vous qui serait intéressé à investir dans ce genre d'instruments ?*

Les petites caisses de pension peuvent avoir un intérêt limité. Ces instruments peuvent répondre à des besoins très spécifiques. Il est néanmoins important qu'ils restent simples.

11. *Pensez-vous que la réforme des prestations complémentaires PC pourra motiver certains fonds de pension à transférer une partie de leur risque de longévité via des instruments financiers dérivés ?*

Nous ne pensons pas que la réforme va motiver les caisses de pension à utiliser ce genre d'instruments. De manière générale, les caisses de pension vont de plus en plus utiliser un régime de contributions plutôt que de prestations. Elles vont également utiliser d'avantage le plan 1E.

12. Si la réforme est acceptée, quel sera l'impact sur le taux de conversion ?

Dans l'absolu, ce taux pourra être revu légèrement à la baisse. Cependant, nous ne pensons pas que la réforme aura une influence sur ce taux.

13. Pensez-vous que cette réforme va accroître le risque de longévité supporté par les fonds de pension ?

Pour la CPEG, cette réforme n'aura aucun impact et selon nous, l'impact ne sera pas significatif pour l'ensemble des caisses de pension. Cette réforme ne va pas faire augmenter grandement le risque de longévité.

Appendix 2 Interview de Monsieur Klein Director of Global Ageing at the Geneva Association

Date 25.04.2018

1. *Do you have a definition of the longevity risk?*

The longevity risk is the exact opposite of the mortality risk. It occurs when people live longer than the expectations made. These expectations set the benchmarks of life expectancies. They are used by companies to provide relevant occupational pension plans and by life insurances companies to propose affordable insurance products.

2. *Do you think that Swiss pension funds should replace all their defined benefit plans for defined contribution plans?*

It would be an extreme measure. However, it is true that defined contributions plans are much more coherent for pension funds. This system enables much more flexibility because it reflects the economic conditions and the return made on the financial markets. Moreover, the conversion rate is currently decreasing. The decrease of this rate diminishes the longevity risk of pension funds.

3. *Do you think that the use of financial instruments could reduce the longevity risk of Swiss pension funds?*

Financial instruments could be an element of the solution to reduce the longevity risk of pensions funds. However, these instruments will never be a complete solution on their own and will not make disappear the longevity risk. In addition to that, we must be truly aware of the counterparty, credit and investment risks linked to these instruments.

4. *Why do Swiss pension funds not use financial derivative instruments (longevity bonds, longevity swaps) to reduce their longevity risk?*

Swiss pension funds are truly conservative and I am really happy about it. They have a huge responsibility regarding the future retired people and must act truly carefully. The main barriers for the use of these instruments are the followings:

- Expensive premiums
- A high level of complexity and low visibility
- Timing when to invest and for what populations

It is also important to invest in the right products and it is at the moment difficult to find a product that fit all the parties. The market of these instruments is still at an early stage and we do not have sufficiently feedback and experience to use them extensively. I would not recommend using a new instrument like a CDO (collateralized debt obligations) because of their complexity and the lack of knowledge about its underlying risk. At my actual knowledge, today it does not exist a full longevity bonds on the market. Good instruments are the longevity swaps because they are tailor-made. The problems with the swaps is the counterparty risk and the fact they have a time frame. What happened if a lot of people are still alive at the end of the swap. In my opinion, the best instrument is the swap out of money. With a swap of money, the goal is to find a party that have an opposite risk than you. For example, let's take a hospital and a ski resort. The number of accident increases drastically during the years with a lot of snow. So, hospitals see theirs costs increasing but the ski resorts see their revenues increasing and the opposite occurs during the years with little snow. Both parties should do a swap out of money. During the year with a lot of snow, a ski resort will share a part of its extra revenues with a hospital and the other way around. I personally did a swap out of money, when I was working at AIG in the life insurance division. At this job, my goal was to mitigate the mortality risk of the company. So, I did a swap out of money with the Pension Benefit Guaranty Corporation (PBGC). This pension funds wanted to mitigate its longevity risk. AIG and PBGC were perfect counterparty. In the case of an epidemic with a lot of deaths; PBGC would be sat on a lot of money (less rents to pay) and AIG will have to cash out a lot of money to pay its life insurances. So PGB would help AIG and the vis-versa. The swap out of money are excellent instruments and create win-win situation for parties. The main difficulty with this system is to find a relevant counterparty.

5. *Do you think that some Swiss pension funds might be interested in these financial instruments?*

I think so especially the independent pension funds which manage by themselves their longevity risk. Nevertheless, I strongly believe that these instruments should only be a small proportion of their total investment (around 5%). What we should keep in mind is that these instruments are relatively expensive. It is fundamental that pension funds keep

investing mainly in various assets in order to generate profits rather than investing exclusively in the transfer of risk. This is not their missions.

6. *Do you consider buy-in and buy-out as financial derivative instruments?*

Not at all, the buy-in and buy-out are simple insurance products that everybody understands perfectly. Moreover, they are very prudent products.

7. *Who has the best position to propose long-term financial derivative instruments (investment banks, assurance companies or reinsurance companies) and why?*

Reinsurance and insurance companies have much more legitimacy to propose this kind of instruments than investment banks. On one hand, insurance and reinsurance companies are used to take risk and manage it. On the other hand, banks stay away of risk. They act as middlemen between parties and just care about the spread and the basis risk. Bankers make a lot of money thanks to these instruments but they do not bear a lot of their intrinsic risks. Thus, there are more risk that they propose inadequate products. Big investors in the capital market could also be interested in providing these instruments because it would diversify a lot their portfolios.

8. *Can you briefly explain the impact of 'Solvency II' and 'Basel III' on these financial instruments and their providers?*

These regulations have an impact on reinsurance companies and investment banks because they force them to hold more capital. The goal is to prevent these companies from liquidity risk in case of financial crisis. It is essential to have regulations to protect the real economy. Nevertheless, there is a main shortcoming with these regulations. The companies regulated always try to beat the regulations by proposing new instruments. These instruments are getting extremely complex. In Switzerland, it exists the Swiss Solvency Test for insurance and reinsurance companies. It is interesting to see that this test is more constringent than Solvency II and Basel III.

9. *Do you think that the use of these instruments can have adverse effects?*

Obviously, the financial crisis of 2008 started with derivative instruments. The problem is the complexity of this kind of instruments. Nobody truly understands their underlying risks.

10. What is the difference between a survival index and a risk model?

The main difference is that an index is fix in time whereas a model evolves through the time. An index is similar to a mortality table and it shows what occurred in the past. A model tries to forecast how mortality rates and life expectancies are going to change in the future. Survival indexes are stating points to propose swaps and mortality bonds. Something important is that both models and indexes look at defined populations.

11. Do you think that the reform of the supplementary benefit will have an impact on the longevity risk of Swiss pension funds? (this reform plans to banish the right of cashing out the second pillar)

First, I do not think that the reform will pass and if it passes they will have made important modifications about the lump-sum of the second pillar. From my point of view, the reform will still allow people to cash out a part of their second pillar. Nevertheless, it is true that the longevity risk of pension funds will definitely increase if it becomes impossible to cash out the second pillar. I hope that the reform will pass because I believe that it is better that pension funds bear longevity risk than individuals. An average person does not have sufficient knowledge and skills to deal with that risk and make the correct investments.

Appendix 3 Interview de Monsieur Hostettler Avocat aux Retraites populaires

Date 02.05.2018

1. *Comment minimisez-vous votre risque de longévité ?*

Premièrement, il est important de comprendre les différentes activités de « Retraites Populaires ». La société est experte en trois domaines distincts : les assurances-vie, la prévoyance professionnelle et la gestion de quatre caisses de pension. Ces caisses de pension sont réparties en deux groupes distincts : les caisses publiques dont font partie la Caisse de pension de l'Etat de Vaud (CPEV) et la Caisse intercommunale de pension (CIP) et les caisses privées dont font partie Profelia et Retraites populaires Fondation de prévoyance.
Toutes ces caisses sont gérées de manière autonome et indépendante les unes des autres. Pour les caisses publiques et Profelia, le risque de longévité est minimisé par du provisionnement. La méthode de provisionnement est la même que la CPEG. La CPEV la CIP et Profelia provisionnent annuellement 0.5% sur leurs rendements respectifs. Retraites Populaires Fondation de prévoyance est entièrement assurée par Retraites Populaires. C'est donc cette dernière qui supporte le risque de longévité en tant qu'institution d'assurance.

2. *Changez-vous vos régimes de prestations pour des régimes de contributions ?*

Les régimes de retraites sont différents entre les caisses privées et les caisses publiques. Les caisses publiques des Retraites Populaires fournissent des régimes de primauté de prestation alors que les caisses privées proposent des régimes de contributions. A l'heure actuelle, les caisses publiques vont conserver leurs régimes de primauté de prestation. Néanmoins, il est intéressant pour nous d'observer ce qui se passe dans le canton de Genève avec le nouveau projet de loi. Selon moi, le risque de longévité est indépendant au régime de retraite. Les caisses de pension ont l'obligation devant la loi de garantir le niveau de rente de la part obligatoire du deuxième pilier. Ce niveau doit atteindre 60% du dernier salaire. Ce niveau de 60% est atteint uniquement si les prestations du premier et du deuxième pilier sont cumulées. Cette obligation s'applique aux régimes de prestations de primauté comme aux régimes de contribution. De plus, il arrive dans certains cas qu'un régime de contribution soit plus avantageux qu'un régime de primauté de prestation.

3. *Quels outils utilisez-vous pour estimer l'espérance de vie des futurs retraités ?*

Nous basons nos estimations à l'aide de tables périodiques et de tables générationnelles. Nous utilisons les tables LPP et les tables VZ. Ces tables sont renouvelées tous les cinq ans. A ce jour, nous utilisons des tables datant de l'année 2015. Il existe un débat dans le milieu de la prévoyance professionnelle concernant le type de table qui permet les meilleures estimations. Certains experts pensent que l'utilisation des tables générationnelles permet d'anticiper d'avantage les évolutions de notre espérance vie et que, par conséquent, le choc à absorber pour les caisses au moment du changement de table est moins important. Cependant, nous n'avons pas le recul nécessaire pour confirmer ou infirmer cette théorie. Nos caisses de pension utilisent d'avantage les tables périodiques. La constitution de ces tables actuaires est possible grâce à la mise en commun des informations de toutes les principales caisses de pension de Suisse.

4. *Dans le cas d'une faillite d'un fonds de pension, qui le sauve ?*

Pour ce qui est de la CPEV, l'Etat de Vaud joue le rôle de garant et réinjecterait des fonds dans la caisse. La CIP a pour garant les communes qui lui sont affiliées. La situation est différente pour les caisses privées. Pour ces dernières, ils existent deux cas de figure. Le premier est que l'assainissement de la caisse est possible. Dans ce cas précis, l'employeur et les employés portent à leurs charges le coût de l'assainissement. L'employeur en réinjectant des fonds et les employés en voyant probablement leurs futures prestations diminuées. Dans le cas où l'assainissement de la caisse est impossible, il existe le fonds de garantie LPP destiné au sauvetage de caisses. Chaque caisse de pension cotise au financement de ce fond. Il existe donc une solidarité indirecte entre les caisses de compensation. Le problème, c'est que ce fond est limité.

5. *Pourquoi les fonds de pension suisses n'utilisent-ils pas d'instruments financiers dérivés alors que de nombreux pays qui ont la même problématique le font ?*

Pour répondre à cette question, il est important de comprendre l'environnement de la prévoyance professionnelle suisse. En Suisse, 60 à 70% des caisses de pension comptent moins de 1000 assurés et il existe moins de 100 caisses dites de grande taille. Les petites caisses de moins de 300 assurés sont considérées à risque. C'est pourquoi elles ont l'obligation légale de réassurer leurs risques d'invalidités et de décès. Ces petites caisses s'occupent peu du risque lié à leurs activités. Elles se concentrent sur leur stratégie d'investissements et sur leurs versements de rentes. Les assureurs Axa, Zurich, Swiss Life, Helvetia et la Bâloise sont les principaux fournisseurs de buy-ins et

buy-outs dédiés à ces petites caisses. Les caisses de taille un peu plus importante, même si elles ne sont pas obligées d'assurer l'ensemble de leurs risques, font tout de même appel à des assureurs ou à des réassureurs. Cette réalité rend le nombre de caisses de pension intéressées par ce genre d'instruments financiers dérivés petit.

6. *Quel est l'avis de l'Association suisse des institutions de prévoyance concernant l'utilisation d'instruments financiers dérivés pour transférer le risque de longévité ?*

L'Association ne prend pas de position spécifique à ce sujet. Elle préfère laisser la liberté de choisir aux caisses de pension. Il est important de laisser de l'autonomie aux caisses de pension pour qu'elles puissent piloter aux mieux leurs actions en fonction des besoins de leurs bénéficiaires.

7. *Pensez-vous que la réforme des prestations complémentaire PC pourra motiver certains fonds de pension à transférer une partie de leur risque de longévité via des instruments financiers dérivés ?*

Le Conseil National n'a pas suivi le Conseil Fédéral et le Conseil des Etats en refusant la mesure concernant le retrait du capital de la partie obligatoire du deuxième pilier. Il est important de comprendre que cette mesure ne s'appliquait que sur la partie obligatoire du deuxième pilier. Par conséquent l'impact pour les caisses de pension n'était que limité, et leur risque de longévité n'aurait pas fortement augmenté. Il est néanmoins vrai que certaines caisses de pension obligent le retrait du capital de la part sur-obligatoire du deuxième pilier, dans le but de transférer le risque de longévité aux bénéficiaires.

Appendix 4 Interview de Monsieur Romanens Directeur adjoint chez Pittet Associés

Date 08.05.2018

Avant de commencer, pour fixer le contexte, je suis expert en caisse de pension chez Pittet et Associés. Pittet et Associés s'occupe principalement de conseil aux caisses de pension sachant que nous avons un panel assez large et diversifié de caisses, qui comprend des caisses privées et publiques. Les caisses publiques restent un petit échantillon du marché suisse. Les différentes caisses fonctionnent de manière différente que ce soient pour la gestion de leurs risques ou leur régime de retraite. Concernant les régimes de retraite, certaines proposent des systèmes de prestations avec des régimes de primauté des prestations alors que d'autres proposent un régime de cotisation. Pour ce qui est de la gestion des risques, certaines caisses sont totalement autonomes alors que d'autres caisses sont partiellement ou totalement assurées. En Suisse, il y assez peu de réassurance pour le risque de longévité. Pittet et Associés en tant qu'actuaire s'occupe de rassurer les caisses de pension, les autorités de surveillance et les assurés concernant le financement des régimes de retraite soit correctement fixé par rapport au retour des marchés financiers.

1. *Comment minimisez-vous votre risque de longévité ?*

Nous utilisons principalement des tables périodiques et parfois des tables générationnelles pour mesurer le risque de longévité de nos clients. Ces tables nous permettent de faire du provisionnement.

2. *Dans quelle mesure les petites caisses de pension sont-elles obligées de transférer leurs risques à des assureurs ?*

Les petites caisses doivent évaluer dans quelles mesures, elles peuvent absorber leurs risques et comment elles décident par la suite de le transférer. Le terme obligation est un peu fort. Néanmoins, il est vrai que l'incitation est conséquente et que les petites caisses transfèrent leurs risques. L'obligation concerne principalement le transfert des risques d'invalidité et de décès car ces types de rente peuvent coûter très cher aux petites caisses. Elle ne touche pas directement le risque de longévité. Le risque de longévité est moins souvent transféré aux assureurs car les actuaires arrivent à l'anticiper et le gérer. Evidemment, cela dépend de ce que propose les assurances et à

quel prix. Nous ne conseillons pas nécessairement nos clients de transférer leur risque de longévité car nous jugeons que ce risque est plus facile à contrôler.

3. *Que pensez-vous des différents régimes de retraite professionnelle et de leur impact sur le risque de longévité ?*

La différence entre les régimes de retraite primauté des prestations ou de cotisations n'influence pas grandement le risque de longévité en Suisse. En Suisse, même avec un régime de cotisations, un niveau minimum de rente doit être garanti et par conséquent les caisses de pension ont, à leur charge, un risque de longévité.

4. *Quels outils utilisez-vous pour estimer l'espérance de vie des futurs retraités ?*

Comme mentionné précédemment, nous utilisons essentiellement des tables périodiques et parfois des tables générationnelles. En Suisse allemande, l'utilisation des tables générationnelles est plus répandue. Nous ressentons une pression à utiliser des tables générationnelles. De manière plus générale, Il existe une tendance au « de-risking » et certains acteurs de la prévoyance remettent en cause le système des tables actuarielles et poussent à l'utilisation d'autres modèles de calcul. Certains voudraient que nous utilisions le modèle à projection multifactoriel anglais CMI (Continuous Mortality Investigation). Il existe un marché pour ces modèles. A l'heure actuelle, il est difficile d'affirmer que le CMI est plus performant que les tables actuarielles. Si le CMI est un jour adopté en Suisse il sera essentiel de le paramétrer aux spécificités suisses. Pour en revenir au système de table, nous avons à disposition deux types de table, les tables LPP et les tables VZ. Les tables LPP sont basées essentiellement sur des informations de caisses privées alors que les tables VZ reçoivent leurs informations majoritairement des caisses publiques. Le problème avec ces tables est qu'elles sont parfois inadaptées à des populations spécifiques. Dans ce cas-là, nous devons ajuster les tables pour être plus précis dans nos estimations. Le principal biais est dû à l'utilisation d'informations de la caisse de la Confédération Publica (plus grande caisse de pension de Suisse) pour constituer les deux types de table. Le problème est que les personnes travaillant pour la Confédération n'ont en général pas la même espérance de vie, que des personne travaillant sur des chantiers. Les différentes caisses de pension ont à leur disposition pour leurs provisionnements les mêmes tables actuarielles or la caisse de pension d'UBS n'a pas la même population qu'une entreprise de construction. Pour les actuaires les ajustements sont compliqués et délicats car il est impossible de recréer des tables par manque de données. Une autre chose qui est intéressante

concernant la longévité, ce sont les points de vue variés et divergents des démographes. Certains pensent que nous arrivons vers un ralentissement de l'espérance de vie alors que d'autres pensent que les nanotechnologies et les progrès de la médecine vont accroître encore la durée de vie. Il est donc difficile de savoir qui écouter et quel modèle utiliser. Ce qui se passe, c'est qu'aujourd'hui les différents acteurs recherchent un maximum de sécurité et à limiter leurs prises de risque.

5. *Dans le cas d'une faillite d'un fonds de pension, qui le sauve ?*

Dans le cas où l'assainissement d'une caisse privée est réputé impossible, il existe un fonds de garantie pour lequel les caisses de pension cotisent. Ce fond peut notamment gérer les engagements d'une caisse insolvable en liquidité. Les caisses publiques ne sont pas liées à ce fonds de garantie car la pérennité de l'employeur garant (un Etat) est considérée comme très importante.

6. *Au sens plus large, quel est le risque de longévité pour les individus, les fonds de pension, les entreprises privées et l'Etat ?*

Si nous y pensons la longévité est une bonne chose pour les individus. Une fois versée, une pension est garantie pour son bénéficiaire. Le risque pour le bénéficiaire est donc presque nul. Ce qui pourrait arriver, c'est la non-indexation des rentes. Aujourd'hui, l'inflation est faible et les rentes ne sont que très peu indexées. Cela n'a pratiquement aucun impact sur les retraités. Cependant, si la situation change avec une augmentation de l'inflation et une non-indexation des rentes, les caisses de pension transfèreraient une partie de leurs risques de longévité aux bénéficiaires.

Pour les actifs, la situation est différente, ils ont à leur charge une part plus importante du risque de longévité, Dans le cas d'un régime de primauté des prestations, ils subissent sur le long terme soit une augmentation de leurs cotisations ou une diminution de leurs futures primes. Dans le cas, d'un régime de contributions, les actifs observent sur le long terme une réduction progressive de leur taux de conversion et par conséquent de leurs futures primes.

Les entreprises privées voient leur part de cotisation augmentée pour garantir les niveaux de couverture des caisses de pension. Les Etats cantonaux et la Confédération ont aussi la fonction d'employeur et devront aussi mettre la main au portemonnaie pour garantir les niveaux de couverture des caisses publiques.

7. *Pensez-vous que cette réforme aurait accru le risque de longévité supporté par les fonds de pension ?*

Oui et non. Le principal problème aurait été la forte augmentation des coûts des nouvelles retraites. Cette mesure aurait aussi eu un impact conséquent pour les petites caisses qui ont déjà aujourd'hui du mal à garantir le minimum légal des rentes. Je pense notamment aux milieux de la restauration et de la construction qui se trouvent dans cette situation. Cette mesure aurait rajouté une contrainte supplémentaire à ces petites caisses et aurait augmenté leurs risques de longévité. De plus, beaucoup de personnes affiliées à ce genre de caisses décident de prendre le capital.

8. *Pourquoi les fonds de pension suisses n'utilisent-ils pas d'instruments financiers dérivés alors que de nombreux pays qui ont la même problématique le font ?*

Le Royaume-Uni où ces produits sont très populaires possède un système de prévoyance professionnelle différent de la Suisse. Au Royaume-Uni, les entreprises privées et leur caisse de pension ne sont pas des entités complétement indépendantes l'une de l'autre comme en Suisse. Les entreprises du Royaume-Uni sont donc confrontées de manière beaucoup plus directe et de manière plus large au risque de longévité. Pour se prémunir de ce risque les entreprises du Royaume-Uni sont dans une stratégie de « de-risking ». Cette stratégie implique le transfert du risque de longévité à des tiers : banques d'investissements, compagnies d'assurances ou de réassurances ainsi qu'aux prestataires. Le but de ces entreprises est de diminuer un maximum leurs charges de prévoyance car les normes comptables IFRS les forcent à les comptabiliser. C'est grâce à ce contexte, que le marché des instruments financiers dérivés a pu se développer autant au Royaume-Uni dans le but de transférer le risque de longévité.
D'autre part, les caisses de pension suisses, n'utilisent pas ce genre d'instruments dérivés car ce sont des produits relativement jeunes avec un coût certain par rapport au niveau de prise en charge du risque de longévité. De plus, les retours sur investissement et les effets positifs de ces produits surviennent sur le très long terme.

9. *Selon-vous qui serait intéressé à investir dans ce genre d'instruments ?*

Selon moi, les grandes entreprises soumises aux normes comptables IFRS soumises à un régime de prévoyance où elles sont directement responsables du risque de longévité. Comme mentionné précédemment, les normes IFRS poussent extensivement au « de-risking » en forçant les entreprises à inscrire dans leur comptabilité leurs différents

risques. Ces normes sont le résultat d'une vision de liquidation des risques en tout temps. Basel III et Solvency II ont le même mode de pensée. A mon avis, ce n'est pas le but du système de prévoyance professionnelle où les caisses de pension ont la fonction d'avoir à leur charge une partie des risques. Pour ce faire, les caisses doivent gérer leurs risques grâce à de bonnes stratégies de financement courant et d'exploitation.

10. Selon vous, y a-t-il des effets pervers liés à l'utilisation de ces instruments ?

Les bénéfices de ces instruments ne se ressentent que sur le très long terme. De plus, ces produits sont récents et nous n'avons pas le recul nécessaire pour les évaluer.

11. Pensez-vous que des fonds de pension suisses sont prêts à transférer une partie de leur risque de longévité via des instruments financiers dérivés ?

A mon sens non. Le problème principal est leurs coûts.

12. Conseillez-vous à des caisses de pension d'utiliser ce genre d'instruments ?

A l'heure actuelle nous ne le faisons pas. Nous estimons que nous sommes en mesure de gérer le risque de longévité. Nous ne jugeons pas le risque de longévité comme l'un de nos risques principaux grâce à sa possible gestion et à nos connaissances sur le sujet. Un de nos principaux problèmes en ce moment concerne le taux technique des caisses de pension. Finalement, pour en revenir aux instruments dérivés, nous ne sommes pas approchés par les fournisseurs.

13. Quel type de fournisseurs est le mieux positionné pour proposer des instruments dérivés pour transférer le risque de longévité (réassurance, assurance, banque d'investissement) ? Et pour quelles raisons ?

Je ne suis pas certain de ma réponse car je ne suis pas un spécialiste de ces instruments financiers. Selon moi, les mieux positionnés sont les entreprises d'assurance ou de réassurance. Ces types d'entreprise auraient même parfois des intérêts à investir dans le risque de longévité. Par contre, je suis sûr que je ne voudrais pas transférer du risque de longévité auprès de banques d'investissement. Le transfert du risque de longévité implique une notion plus biométrique que financière. Ce qui positionnent moins bien les

banques d'investissement. De plus, le but est aussi de limiter les intermédiaires et de favoriser les circuits directs lors du transfert de risque.

Appendix 5 Interview de Monsieur Maeder Professeur en actuariat à l'université de Lausanne et ancien employé de Swiss Re

Date 09.05.2018

1. *Pourquoi les fonds de pension suisses n'utilisent-ils pas d'instruments financiers dérivés alors que de nombreux pays qui ont la même problématique le font ? Quelles sont les principales différences et particularités de ces marchés ?*

Il existe deux raisons principales. Premièrement, contrairement à d'autres pays comme le Royaume-Uni, le système de prévoyance suisse sépare l'entreprise de la caisse de pension. Ce sont deux entités légales complétement distinctes qui ont leurs propres risques. Au Royaume-Uni, le système est différent. Les entreprises privées ont à leur charge l'ensemble des risques liés aux activités de leur caisse de pension. Pour cette raison, ces entreprises ont une logique de «de-risking » et transfèrent leurs risques de longévité à un maximum de participants. Elles le font notamment grâce à l'aide d'instruments financiers dérivés. En plus de cela, le transfert du risque de longévité était encore plus facile au Royaume-Uni avant l'instauration de Solvency II. Avant Solvency, les assureurs aux Royaume-Uni avaient la possibilité de retransférer leurs risques à des compagnies de réassurance à des tarifs attractifs. Cet accès, à des prestations avantageuses, était dû aux plus faibles besoins en capitaux des compagnies de réassurance.

La seconde raison principale pour la non-utilisation de ces instruments en Suisse est liée aux réassureurs et aux banques d'investissements qui ne sont intéressés que par de très conséquents transferts de risque de longévité. Quand je travaillais chez Swiss Re, j'ai entendu que les compagnies de réassurance trouvaient les transferts de risque de longévité intéressants avec des caisses ayant au minimum cinq milliards de US dollars dans leur bilan. En Suisse, le marché est très restreint pour les fournisseurs de ces produits car les caisses de pension sont majoritairement trop petites. J'aimerai ajouter que ces instruments ne proposent pas une couverture (hedge) parfaite du risque de longévité.

2. *Selon vous, qui serait intéressé à investir dans ce genre d'instruments ?*

Pour que ces instruments fonctionnent, le fournisseur et l'acheteur doivent être gagnants sinon le produit n'a pas sa raison d'être. Comme je l'ai dit précédemment, en Suisse le marché est très limité. Les seules caisses qui pourraient être intéressées sont les très grandes caisses privées où l'Etat n'est pas garant. Les caisses privées de plus petites tailles n'ont pas d'intérêt à utiliser ce genre d'instruments car ils leur coûteraient beaucoup trop chers par rapport aux bénéfices qu'elles en retireraient. D'autre part, le point de vue des réassureurs sur les marchés où ces instruments financiers fonctionnent est aussi intéressant. Les réassureurs ont observé une anti sélection (adverse selection) lors de la vente de ces produits. Les caisses de pension qui assurent leur risque de longévité ont souvent des populations qui vivent plus longtemps. Ce constat les a amenées à augmenter leurs premiums.

3. *Quel type de fournisseur est le mieux positionné pour proposer des instruments dérivés pour transférer le risque de longévité (réassurance, assurance, banque d'investissement) ? Et pour quelles raisons ?*

Les réassureurs sont les mieux positionnés devant les banques d'investissement car les compagnies de réassurance sont porteuses du risque, pas les banques. Les entreprises d'assurances contrairement aux banques d'investissements et aux compagnies de réassurance n'ont pas la capacité de concevoir ces instruments dérivés car ces instruments nécessitent des modélisations actuarielles.

4. *Quels sont les marchés (pays) où sont utilisés le plus d'instruments dérivés pour transférer le risque de longévité ?*

Il s'agit en grand majorité du Royaume-Uni même si d'autres pays commencent à le faire. Je pense notamment aux Pays-Bas, aux Etats-Unis et au Canada.

5. *Proposez-vous des instruments financiers types Swap ou obligation de longévité à des caisses de pension en Suisse pour transférer une partie de vos risques ?*

Non Swiss Re ne le fait pas.

6. *Selon vous, y a-t-il des effets pervers liés à l'utilisation de ces instruments ?*

Ces instruments ne sont bons que si les index sur lesquels ils sont basés sont bons et représentent efficacement les espérances de vie des populations. De plus, ces index doivent être mis à jour très fréquemment pour suivre de manière précise les évolutions de l'espérance de vie. En Suisse par exemple, il serait très compliqué d'avoir un excellent index car nous manquons de données statistiques. Le bassin de population de huit millions d'habitants est trop faible.

7. *Pensez-vous que des fonds de pension suisses sont prêts à transférer une partie de leur risque de longévité via des instruments financiers dérivés ?*

Je ne le pense pas. Les produits sur le marché ne sont pas adaptés aux besoins des caisses de pension suisses et sont beaucoup trop chers. Selon moi, la stratégie de « de-risking » pour les caisses de pension suisses est inadapté car notre système de prévoyance est différent. Le risque de longévité est surfait. Le risque de longévité n'a jamais mis une société en faillite. L'exemple des Rentes Genevoises le montre. Les Rentes Genevoises ont commencé leurs activités en 1852 et au début se consacraient uniquement au risque de longévité. En Suisse, les petites caisses ont l'obligation de transférer leurs risques d'invalidité et décès mais pas celui de longévité. Les risques d'invalidité et de décès peuvent avoir des conséquences plus importantes pour les petites caisses que le risque de longévité. Ce qui est problématique en Suisse, c'est que dans certains cas les taux de couverture sont des leurres car ils sont calculés sur des tables actuarielles trop optimistes. Dans le cas où une entreprise privée part en faillite, sa caisse de pension continue de verser des rentes aux actuels bénéficiaires. Si cette caisse à un taux de couverture de 100%, basé sur des tables actuarielles précises, cette caisse est en mesure de respecter l'ensemble de ses engagements. Si par contre, ce taux a été mal évalué, la situation est différente. Pour se prémunir de ce problème, la caisse de pension de la Migros a pour objectif d'avoir un taux de couverture à 118%.

8. *Dans quelle mesure Basel III et Solvency II sont contraignantes pour l'émission de ces instruments dérivés ?*

Basel III et Solvency II limitent la capacité de vendre de manière très large ces instruments financiers dérivés car ils imposent des niveaux de capital et de fonds propres minimums aux banques d'investissements et aux compagnies d'assurance et

réassurance. C'est pourquoi, si le marché de ces instruments veut se développer, les acteurs doivent trouver de nouveaux participants pour couvrir les différents risques. Je tiens à ajouter que certains régulateurs souhaiteraient étendre Solvency II aux caisses de pension. Selon moi, c'est une mauvaise idée car Solvency II est un modèle inadapté aux caisses de pension car trop strict. Les caisses de pension et les assureurs n'ont pas les mêmes objectifs et les mêmes besoins. Il faudrait donc développer un modèle propre aux caisses de pension.

9. *Quel index utilisez-vous pour définir le prix et les profits de ces instruments ?*

Swiss Re utilise les index proposés par Life and Longevity Market Association. Si le transfert de risque concerne une population qui n'a pas d'index fait par le LLMA, Swiss Re « crée » avec la caisse de pension un index pour cette population grâce aux données qu'elle a à sa disposition.

10. *Quels outils utilisez-vous pour vous assurer de la viabilité de ces instruments ? (Par exemple the Berliner Framework)*

A ma connaissance, le Berliner Framework n'a jamais été utilisé pour ce type d'instruments. Monsieur Berliner, n'est jamais devenu riche grâce à cet outil. Pour être honnête, je ne sais pas exactement comment les fournisseurs de ces produits garantissent la viabilité de ces instruments. Ils se basent évidemment sur des index lors de leur conception.